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THE PERISTIGMAL GLAND CELLS OF TRYPETID LARVAE

(Diptera)

MARSTON BATES,
Museum of Comparative Zoology, Harvard University, Cambridge, Mass.

Dolley and Farris (1929) have given a brief résumé of the previous work on the peristigmal gland cells of Syrphid larvae, which need not be repeated here. The wide occurrence of these gland cells in the larvae of the higher Diptera has not, however, been generally recognized. Pantel (1901) found them in the larvae of entomophagous muscids, and Keilin (1913) reports their presence in the Mycetophilidae, Psychodidae, Ptychopteridae, Rhyphidae, *Trichocera*, and in all of the cyclorrhaphous Diptera studied. Yet in the numerous papers that have been published on the larvae of the Trypetidae, no reference to these gland cells has been found, except a bare mention in the article on *Anastrepha striata* by Keilin and Picado (1920). As these structures present several problems of considerable physiological and histological interest, the present notice of their general occurrence in the fruit-inhabiting Trypetidae may be of value. *Rhagoletis pomonella* has been selected for illustration, as it is the most generally available form; its larval anatomy has been described by Snodgrass (1924).

These giant gland cells were first observed in the course of a general study of the histology and anatomy of the fruit flies, which was made under the supervision of Prof. A. B. Dawson, to whom I am indebted for innumerable suggestions. Prof. R. H. Painter kindly supplied some larvae of *Euaresta aequalis* for study. The glands have been found in *Toxotrypana curvicauda*, *Anastrepha ludens*, *A. striata*, *A. acidusa*, *A. serpentina*,

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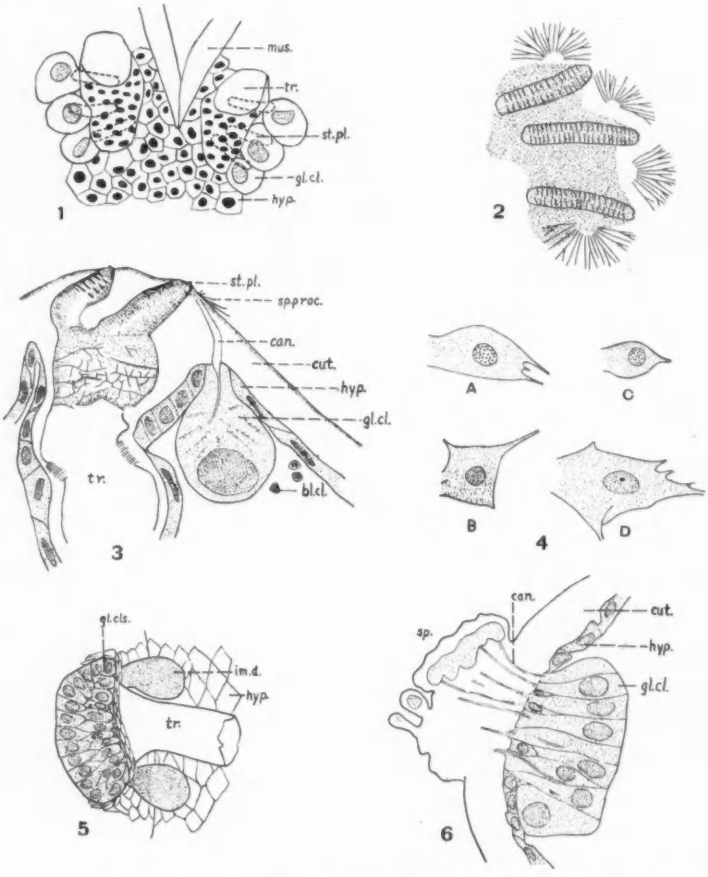

(All figures are camera-lucida drawings from single sections or whole mounts, except Fig. 3.)

Fig. 1. *Rhagoletis pomonella:* topography of body wall about the posterior spiracles, from the inside.
2. *R. pomonella:* posterior spiracle, showing stigmatal plates and interspiracular processes.
3. *R. pomonella:* longitudinal, horizontal section of posterior spiracle; part of the duct and the nucleus of the gland cell are drawn in from adjacent sections.
4. Gland cells from whole mounts of the posterior spiracles of various Trypetidae: A, *Anastrepha serpentina;* B, *Anastrepha ludens;* C, *Ceratitis capitata;* D, *Toxotrypana curvicauda.*
5. *R. pomonella:* topography of region about anterior spiracle.
6. *R. pomonella:* oblique section through anterior spiracle.

A. fraterculus, *Rhagoletis pomonella*, *R. suavis*, *Ceratitis capitata* and *Euaresta aequalis*. They were not found in hibernating larvae of *Eurosta solidaginis*. For study, the caudal end of the maggot was removed, carefully cleaned, stained in eosin Y and Ehrlich's hematoxylin, and mounted on a slide sufficiently thin to permit the use of the high dry objective from either side. This, incidentally, is an excellent method of mounting the posterior spiracles for purely taxonomic study. Sections were made from tissues imbedded by the ordinary double celloidin-paraffin technique. Good results were obtained with material that had been fixed in hot water alone, although various other fixatives were also employed.

Anterior spiracle. The gland cells about the anterior spiracle are arranged to form a compact mass cephalad to the end of the tracheal trunk. The outline shown in Fig. 5, of *Rhagoletis pomonella*, is typical of all of the species examined. Figure 6 shows an oblique section through this region. The gland cells are apparently modified hypodermal cells, with simple intracellular ducts which lead out through the cuticula to empty into the outer chambers of the spiracle. In *R. pomonella* there are about 25 of these cells associated with each spiracle.

Posterior spiracle. Figure 1 is a sketch of the region of the posterior spiracles, drawn from a whole mount of the caudal end of a larva and viewed with the inner surface uppermost; for better orientation the locations of the stigmatal plates are indicated. In all of the fruit-feeding larvae examined, a large glandular, hypodermal cell is located just distal to each of the six stigmatal plates. These cells are generally about as long as the corresponding stigmatal plates, or occasionally longer. In *Rhagoletis* they vary from 0.06 to 0.07 mm. in length; in *Anastrepha* the cells may be much longer, reaching a maximum size, exclusive of the long protoplasmic processes, of about 0.2 mm. in *Toxotrypana*. In *Rhagoletis* these cells are rounded; in most of the other genera they are irregular in outline, drawn out into processes (Fig. 4). In whole mounts, these processes are usually broken off in clearing away the fat body, but in sections of *Anastrepha* they are seen to run for considerable distances, until they are finally lost on the muscle of the body wall. The function and nature of these protoplasmic processes could not be determined; they are not to be confused with nerve fibers, which are abundant in the same region. In many respects these cells are strikingly similar to the nephrocytes of the same animals. It is

EXPLANATION OF ABBREVIATIONS USED IN THE FIGURES

bl. cl.—blood cell.
can.—duct of gland cell.
cut.—cuticular (chitinous) layer.
gl. cl.—gland cell.
hyp.—hypodermal cell layer.
im. d.—imaginal disc.
mus.—muscle.
sp.—spiracle.
sp. proc.—interspiracular processes.
st. pl.—stigmatal plate.
tr.—trachea.

interesting to compare them with the structurally similar hypodermal gland cells found on the legs of the beetle *Epilachna*, described by McIndoo (1916).

Figure 3 is taken from a horizontal longitudinal section of *Rhagoletis pomonella*. Each gland cell characteristically shows a well developed internal duct, which can be shown to extend for well over half the length of the cell. It passes to one side of the nucleus, but does not seem to coil as extensively as in the similar cells described by Wahl (1899) in the Syrphidae. On leaving the cell, the duct enlarges very appreciably; it extends through the cuticula to end just beneath a set of chitinous filaments—the "interpsiracular processes" of Efflatoun (1927).

There are four sets of interspiracular processes, as shown in Fig. 2, but only three gland cells. Only one instance of a doubled gland cell has been observed—in *R. pomonella*. I have been unable to determine with any certainty whether the duct of one cell branches, or whether one set of processes has no associated gland. The latter seems more likely from the evidence at hand. These interspiracular processes have been described in some detail for a large variety of Trypetidae by Efflatoun (1927). They constitute excellent taxonomic characters, although somewhat difficult to distinguish in unmounted larvae.

The possible function of these gland cells in the Trypetidae is pure speculation; but the theory proposed by Wahl (1899), who suggests that the cells secrete a fatty substance which may prevent the entrance of fluids into the spiracles, seems most plausible.

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NOTES ON THE BIOLOGY OF ACANTHOLOMA DENTICULATA STAL

(Hemiptera, Scutelleridae)

H. M. HARRIS AND FLOYD ANDRE[1]
Ames, Iowa

Late in June of the past season, 1932, it was our good fortune to discover specimens of that interesting little turtle-shaped bug, *Acantholoma denticulata* (Plate II, Fig. 1), feeding on the flower-heads of a native perennial plant in the vicinity of Ames. Since the species had not been recorded from Iowa and since so little had been written concerning the biology of shield-backed bugs in general, efforts were made to study its life and habits. The notes resulting from our studies and observations are presented here as a contribution to the general knowledge concerning the family Scutelleridae.

HISTORY AND DISTRIBUTION

The literature of entomology contains very few references to this particular species. The genus in which it is placed was erected by Stål in 1867, but through his failure at that time to name an included species was not validated until three years later when *denticulata* was described and referred to it. Stål's type specimens of *denticulata* were from Illinois. Since the time of the appearance of its original description the species has been recorded from Kansas, Indiana, and New York. In 1904 Schouteden, in his treatment of the *Scutelleridae* for the Genera Insectorum, published an excellent figure of this form. More recently, Blatchley (1926) noted certain differences between Illinois and Kansas specimens then before him and for the latter proposed the varietal name *kansiana*—a name which unfortunately was based on external sexual differences between the male and female.

It would seem from our observations that the geographical distribution of *Acantholoma denticulata* is limited by the range of its host plants, *Cèanothus pubescens* (T. & G.) Rydb. and the

[1]The authors are indebted to Dr. C. J. Drake, who made it possible to include the plate of the life stages. Acknowledgments are also made to Dr. H. H. Knight and Mr. H. G. Barber for comparing specimens, and to Dr. R. C. Smith for the loan of specimens. The drawings were made by Esther L. Travis.

related *C. ovatus* Desf. Certainly the development of its life-stages in Iowa is synchronous with and dependent upon the time of flower and seed production of the former of these plants. In June, when *Acantholoma* was discovered on *C. pubescens*, the majority of the seed-heads were just attaining their full growth and a few of the older ones were ripening. At that time no immature stages of the bug could be found, although many other Hemiptera were present as late-instar nymphs or first generation adults. Because of this fact, and because of the presence nearby of a second species of *Ceanothus* whose blossoms had not yet begun to open, we were led to surmise that the insect would later transfer its attentions to the developing seeds of this second plant (*C. americanus* L.). To explain the apparent rarity of *A. denticulata* then, we proposed to ourselves the hypothesis that the insect had two generations annually, the one developing on the early maturing *Ceanothus* and the other on the later maturing species, and that, therefore, the two forms of plant must be present in order for the bug to survive in a given locality. At no time, however, was *A. denticulata* found feeding on *C. americanus*, and this pretty picture soon had to be discarded.

RELATION TO OTHER SCUTELLERIDAE

Acantholoma is a monotypical genus. It belongs to that group of shield-bugs, the *Tetyrinae*, the species of which have finely ridged stridulatory areas occupying parts of the fourth and fifth segments on each side of the venter. The pronotum is transversely impressed across the disc, a character which links the genus with *Camirus* Stål, with which it indeed is very closely related. From *Camirus*, however, *Acantholoma* is to be recognized by the distinctly dentate lateral margins of the head and pronotum.

The varietal name, *kansiana*, was proposed by Dr. Blatchley for specimens of *A. denticulata* from Riley County, Kansas, (collected in June, by Marlatt). This variety was said to be recognizable from the typical variety by its smaller size and by certain characters of the genital plate. When the writers secured their first Iowa specimens the question arose as to whether they were of the typical (Illinois) form or whether they represented *kansiana*. Close study soon disclosed that the males apparently were of the variety *kansiana*, whereas the structure of the female genital segments agreed quite closely with the description of the male genital plate of the typical variety as described by Dr. Blatchley. In order to clear up the confusion our specimens from Iowa subsequently were compared by Dr. H. H. Knight with Illinois specimens in the collection of the Illinois State Natural History Survey, and by Mr. H. G. Barber with Kansas specimens in the United States National Museum. Neither Dr. Knight nor Mr. Barber was

able to find noticeable differences between the specimens compared. Still later a series of specimens bearing the same date-locality data as the type of *kansiana* was found in the collection of the Kansas State College and made available for study through the courtesy of Dr. Roger C. Smith. As a result of all these studies it is very evident that variety *kansiana* represents the male sex of typical *A. denticulata*, and that Dr. Blatchley's description of what he calls the male of the typical variety is in reality a characterization of the female.

DESCRIPTION OF LIFE STAGES

The Egg.—Strictly of the pentatomid type; almost spherical, but slightly flattened above and below. When fresh, about 0.91 mm. in diameter and pale robin's-egg blue in color. Chorion finely sculptured, appearing irregularly, hexagonally reticulate, its upper area or anterior pole marked with a circlet of 15 or 16 unevenly spaced, short, chorial or micropylar processes (Plate I, Figs. 6 and 7).

The eggs are placed in irregular groups of two to six, the latter number apparently being the usual and normal sized group. As incubation proceeds the size increases to slightly more than 1 mm. in diameter, and the egg becomes characteristically marked with crimson spots.

First Instar.—Shiny, coarsely punctured, entirely naked except for a few short, fine, pale hairs on margins of head and thorax and numerous fine hairs on antennae and legs. Brown, the eyes, a fine, median longitudinal line on thorax and three broader, transverse lines on abdomen (the first placed between thorax and abdomen and connected to second on each side near margin) reddish, almost crimson. Antennae and legs pale brownish testaceous, the apices of antennals II and III whitish; the tarsi also paler. Venter reddish, its disc and the broad margins dark brown. Head, shallowly punctured, its margins explanate and reflexed, with a blunt tooth before each eye; width, 0.69 mm. Antennae four-segmented, in the proportion—I : II : III : IV : : 6 : 5 : 5 : 13. Rostrum reaching to base of venter.

Thorax with the three segments distinct, entirely separate; lateral margins broadly explanate and reflexed, without teeth; mesothorax slightly produced posteriorly at the middle. Tarsi biarticulate, the first segment short. Abdomen with margins broadly explanate and reflexed, with seven segments above before the genitals, segments I–III short, IV–VI longer, each almost as long as the first three conjoined; repugnatorial glands opening between segments IV and V, and V and VI, respectively. Spiracles blackish, placed on sides of venter. Length, 1.35 mm.; width, 1.05 mm. (Pl. I, Fig. 1).

Second Instar.—Dark brown, rather thickly punctured, each puncture with a short, flattened, somewhat curled, whitish hair arising from its base. Abdomen with the sides mesad to connexiva and the intersegmental membranes pale, these pale markings especially apparent when the abdomen is distended, the dark punctures then causing the sides above and beneath to be speckled. Connexivum alternated. Head and thorax with the side margins conspicuously dentate, the two teeth in front of eyes much larger than the others; head width, 9 mm.

Antennal proportions, 10 : 7 : 6 : 17. Pronotum arched, separated from mesonotum by a broad, deep, transverse depression. Mesonotum strongly produced posteriorly along the middle, metanotum there correspondingly narrowed (Pl. I, Fig. 2). First and second abdominal tergites narrow, third lengthened on each side, fourth and fifth wide, transversely oval, their odoriferous orifices marked by a more or less median transverse ridge which is delimited on each side by a prominent tubercle. Legs setose. Length, 1.9 mm.; width, 1.35 mm.

Third Instar.—Coloration about as in previous instar, the thorax with a black spot on each side occupying parts of both mesonotum and metanotum. Head just in front of eyes, and disc of pronotum with smooth, shiny cicatrices. Head width, 1 mm. Antennal proportions, 11 : 9 : 8 : 20. Mesonotum more strongly produced than in previous instar. Length, 2.32 mm.; width, 1.75 mm. (Pl. I, Fig. 3).

Fourth Instar.—Darker and more heavily chitinized than in previous instars, the punctures more numerous, the hairs arising from their bases distinctly uncinate. Head width, 1.35 mm. Antennal proportions, 13 : 13 : 10 : 21. Thorax with a faintly raised, median smooth line. Mesonotum at median line extending back almost as far as metanotum, also produced on each side as small wing pads (Pl. I, Fig. 4). Legs setose, the coxae, trochanters, and bases of femora whitish. Length, 3.42 mm; width, 2 mm.

Fifth Instar.—Head blackish; width, 1.54 mm. Antennal proportions, 16 : 19 : 14 : 28. Pronotum strongly, transversely depressed before the base, the marginal teeth proportionally smaller than in previous instars. Mesonotum (scutellum) more strongly produced posteriorly, entirely covering metanotum, broadly rounded behind, its median length considerably greater than that of pronotum. Wing pads conspicuous, extending as far posteriorly as the mesonotum (Pl. I, Fig. 5). Coxae, trochanters, and bases of femora whitish. Tarsi biarticulate. Length, 4.1 mm; width, 2.5 mm.

Adult.—Moderately convex, oblong oval, the female faintly widened posteriorly. Dull black, often with an aeneous luster; sometimes with a minute to medium-sized, smooth spot on each side of scutellum at its base, a short, obsolete linear streak on its median line beyond the middle, and small spots at the outer basal angles of the connexival segments testaceous to ivory-white. Antennae and tarsi brownish. Entire body thickly, coarsely punctate, each puncture bearing a short, curled, semirecumbent pale hair. Head strongly declivent, as seen from above broadly rounded in front; the margins narrow, reflexed, and minutely, irregularly, dentate. Tylus raised. Ocelli minute, reddish. Eyes reddish, not projecting as far laterally as front margins of pronotum. Antennae darkened distally, finely pubescent; five-segmented, the joint between segments II and III not noticeably constricted; proportion of segments, 25 : 16 : 11 : 15 : 32. Bucculae explanate, their margins broadly rounded. Rostrum reaching to first segment of venter.

Pronotum with an interrupted, deep impression across its middle, the front margin slightly sinuate, the humeri prominent; the lateral margins almost straight, converging anteriorly, slightly explanate and

minutely, irregularly dentate (Pl. II, Fig. 1). Scutellum almost completely covering abdomen, gradually declivent behind the middle, irregularly, transversely rugose towards the base, with an indistinct, median longitudinal, smooth raised line, the punctures of the disc noticeably finer than those of pronotum. Hemelytra with exposed costal margin reaching almost to middle of scutellum. Propleura explanate in front, the margins straight, forming an obtuse angle covering the insertion of antennae. Meso- and metasternum deeply sulcate for the reception of the rostrum. Legs with short setalike hairs arising from fine, raised granulations; tarsi brownish, tri-articulate, the middle segment shortest. Venter coarsely punctate, the fourth and fifth visible segments on each side with oblong, stridulatory patches. Male genital segment semicircular, the surface almost flat, finely punctured, the upper or hind margin convex, faintly raised. Female genital segments almost semicircular, the division between the basal plates forming a fine, median, lengthwise suture on the front portion; the apical plates transverse, narrowed laterally. Length, (♂) 4.3 mm.; (♀) 5.2 mm. Width, (♂) 3 mm; (♀) 3.6 mm.

LIFE HISTORY AND HABITS

Methods of Study.—Eggs of a known age were obtained by placing mating pairs in small stender dishes containing leaves and seeds of the host plant, and by keeping numbers of adults in lamp-chimney cages containing branches of the host in vials of water. These cages were examined daily and the eggs removed and placed in vials and dishes for a study of the incubation period. When hatching occurred most of the nymphs were removed to individual stender dishes. At times, however, all the young from a given batch of eggs were kept together in a single cage and studied as a group. It was necessary to conserve the moisture in the cages as drying was soon fatal to the nymphs. Best results were obtained by placing slightly moist disks of absorbent paper in the cages, and then keeping a pinch of leafmold and a few sprigs of fresh grass in each. The cages had to be cleaned regularly and fresh material added to hinder growth of fungi.

Attempts to use various parts of the host, and of other plants growing near it in nature, as food for the young bugs were without success until a nymph was discovered with its piercing stylets embedded for their entire length in a soft, mold-covered seed of the *Ceanothus*. This particular seed upon investigation was found to contain the mutilated larva of a small hymenopteron, but it gave the clue as to the necessary food. Thereafter dried seeds of *Ceanothus*, softened by soaking in water, were used as food. In some cases crushed seeds were used with equal success. Occasionally, nymphs were observed to test moistened leafmold with their beaks, and some were seen to insert their stylets into grass stems from which they apparently took the juices. However, all efforts to rear nymphs on such material in the absence of seeds of *Ceanothus pubescens* proved futile. Field observations were made regularly in connection with the insectary studies.

The Eggs.—The ova of *A. denticulata* normally are deposited in a more or less regular mass composed of two rows of three eggs each

(Pl. II, Figs. 2 and 3). In no case observed were there more than six eggs in a batch, and in only a few scattering cases were there less than six. The greatest number of ova produced by an individual was eighteen, but as the several specimens laying this number may have oviposited before they were caught in the field, eighteen does not necessarily represent the full complement of ova. In our experiments, the eggs were deposited on the foliage of the host or in the leafmold kept in the cages. Although diligent search over and around the foliage of the host in nature was made time after time, eggs were found in only one instance. These were in a curled and partly decaying leaf taken from the vegetable mold beneath *Ceanothus*. In the cages oviposition first occurred on June 22 and continued throughout July.

As incubation progressed, the delicate blue color of the egg was gradually lost, and reddish spots forming on the embryo began to show through the chorion (Pl. II, Fig. 2). The eyes of the developing nymph became very conspicuous and the somewhat T-shaped egg-burster soon was black and quite prominent. This egg-burster (Pl. I, Fig. 7) was situated dorsally at the anterior or upper end of the egg, and by its position it was possible to see that the eggs in a given group were so arranged that the dorsal sides of all were turned in the same direction. As seen from above, the reddish to crimson spots were arranged in seven rows—one ventral, two ventrolateral, two lateral, and two dorsolateral. A broadly oval, disklike area of the chorion large enough to allow the nymph's emergence was pushed away at the upper end of the egg at the time of eclosion. By examining the white and transparent empty shell it was seen that the lid or cap did not correspond in extent with the area within the circle of chorial processes (Pl. I, Fig. 7). The cap along with its egg-burster remained attached to the empty chorion. A few of the eggs hatched five days after their deposition, others took eight days, and the average length of the incubation period for all of the ova studied was seven days.

The Nymphs.—Recently emerged nymphs of *A. denticulata* were more or less gregarious, herding together in small aggregations as is characteristic of pentatomid young in general (Pl. II, Fig. 3). They spent a large portion of the time huddled thus, with their appendages retracted under the body. Nymphs of the older instars became more active, lost their gregarious habit, and wandered restlessly about testing various materials with the beak in their search for food. In nature, nymphs were found stalking along in the leafmold and feeding on the seeds of *Ceanothus*. The seeds of this plant have a very durable coat through which the bugs had to drill in order to obtain their food. When a puncture was once made, however, the stylets were unsheathed and probed back and forth accompanied by an up and down motion of the head, the labium being folded back under the body.

At molting the integument ruptured along the median line of the thorax. In front this splitting was continued obliquely across the occiput to the inner margin of the eyes; posteriorly there was a transverse rupture along the suture between the thorax and abdomen. The recently emerged nymphs were pale but soon became suffused with pinkish pigment and gradually took on their darker coloration.

Ecdysis usually was preceded by a short quiescent period. There were five nymphal instars. The minimum, maximum, and average lengths of time spent in each stadium are given in the accompanying table, which is a summarization of our data on thirty-four specimens carried from the egg to the adult stage in individual cages. Records on other specimens, kept in groups, show no material disagreement from these data. The shortest period of time required for any example to complete all the stages in development was 45 days, and the maximum length of time was 51 days.

TABLE I

Duration of Life Stages of *A. denticulata*

Stage	Time in Days		
	Minimum	Maximum	Average[2]
Egg	5	8	7
1st Instar Nymph	5	7	5.5
2nd Instar Nymph	6	11	8
3rd Instar Nymph	4	9	7
4th Instar Nymph	4	10	6.5
5th Instar Nymph	10	20	13.4

[2]Average of 34 specimens carried from egg to adult in individual cages.

A study of our records of the development of the nymphs discloses that whenever the time spent in a given stage was increased (or decreased) through any cause there was a consequent decrease (or increase) in the length of the succeeding stadia. In other words, if the percentage of development for any stage was increased (or decreased) over that normal for that particular stage there was a compensating change in the developmental increment for the succeeding stages. To illustrate, specimen number 4 in our records hatched in five days time, which was two days less than the average, but it required seven days to complete the first stadium, which was 1.5 days more than the average. Again, specimens 6 and 7 (hatched on the same day) spent 10 and 4 days respectively as fourth-instar nymphs, then required 14 and 20 days respectively to complete their last nymphal stadium.

The Adults.—During the last week of June and the first half of July adults of *Acantholoma denticulata* Stål were found congregated on the ripening seeds in the corymbs of *Ceanothus pubescens*. The individual seed-stalks of this plant, as well as the individual seed-pods of a given stalk, matured irregularly, some being in a much more advanced stage of ripening than others. As the pods ripened they became blackish in color and so it was difficult, without careful scrutiny, to discover the dark, oval scutellerids lurking amongst them. When disturbed the bugs folded their appendages and tumbled from their perches, soon, however, to begin wandering restlessly through the leafmold on the

ground and up and down the stems of plants in efforts to regain their former positions in the seed-heads. This habit of feigning death made it possible to collect the adults very easily at that season simply by quietly approaching the plants and cupping the hands beneath the seed clusters. The adults were never observed to make any effort to fly.

Mating individuals were first found in the field on June 22. Thereafter for several weeks various pairs were at times seen in coitu. The method of becoming coupled was never observed, however the mating individuals, which often remained in coitu for several hours, were always found facing in opposite directions with their caudal segments in apposition. During these periods they were more sluggish and moved slowly about, at times taking food.

Hibernation occurs in the adult stage, specimens having been taken at Ames in leaf mold from around *Ceanothus pubescens* during September, October, December, and February.

THE HOST PLANT

Ceanothus, sometimes called "red-root," is a shrubby plant belonging to the Buckthorn family. The species, *pubescens* (T. & G.) Rydb., is by many considered to be only a variety of *ovatus* Desf. It occurs on dry, rocky hillocks and is said to range southwestward from Iowa. *Ovatus* ranges from Vermont and Massachusetts to Manitoba and Minnesota and southwestward. At Ames, *C. pubescens* has been found at only one place, though the related and later maturing *C. americanus* L. occurs abundantly.

When the seeds of *C. pubescens* have completely matured the pods or capsules in which they develop dehisce producing a rather audible clicking sound and ejecting the seeds with considerable force. On a bright sunny day in late July the air in the vicinity of these plants is filled with the hurtling seeds. They possess a hard, durable coat, but as they come to lie in the mulch and ground vegetation take up moisture and thus are sufficiently softened that the nymphs and adults of *A. denticulata* living there can penetrate them.

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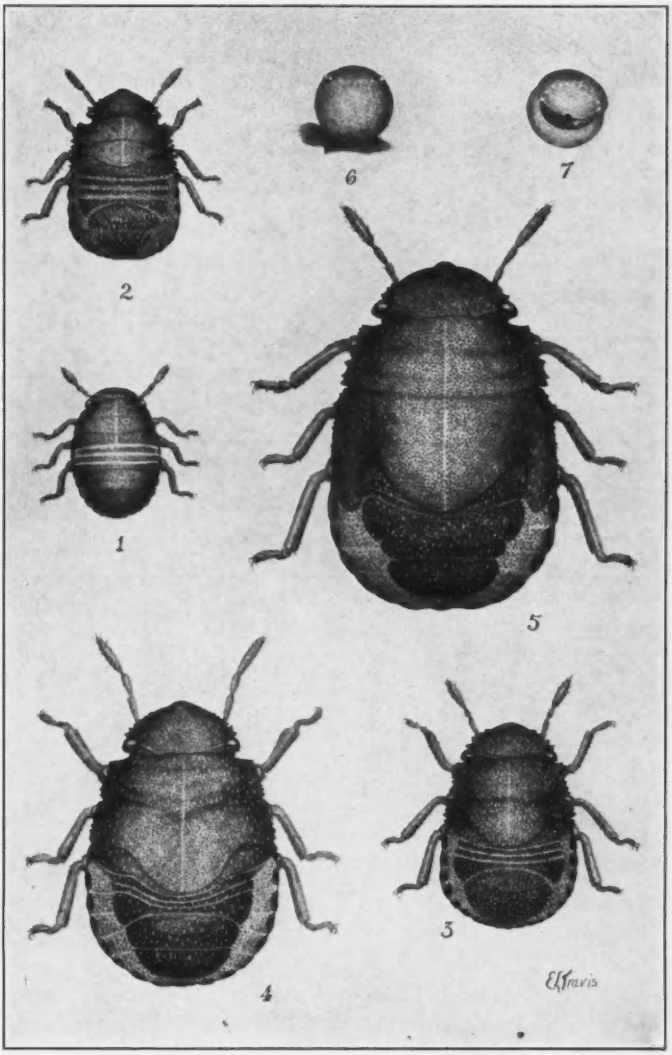

Figs. 1-7. *Acantholoma denticulata* Stål. 1, First-instar nymph. 2, Second-instar nymph. 3, Third-instar nymph. 4, Fourth-instar nymph. 5, Fifth-instar nymph. 6, Egg, side view. 7, Empty chorion showing egg-burster and chorial processes from above.

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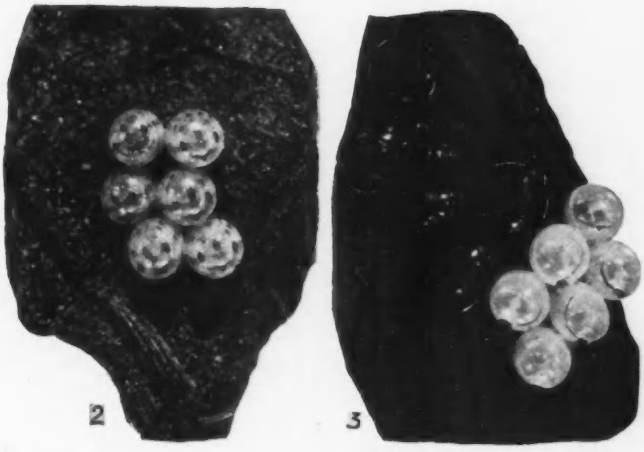

Figs. 1-3. *Acantholoma denticulata* Stål. 1, Adult. 2, Egg-mass on leaf. The egg-burster and the eyes and color markings on the developing embryos show through the chorion. 3, Recently hatched nymphs and the egg-shells from which they emerged.

REPRODUCTION IN MEALYBUGS

A. J. BASINGER,
University of California Citrus Experiment Station,
Riverside, California

During studies of *Pseudococcus gahani* Green and *Phenacoccus gossypii* T. & Ckll., observations were made on the reproduction of these two species of mealybugs that may be of interest to coccidologists. Schrader (1923) in his studies of *Pseudococcus citri* (Risso) determined that the species is non-parthenogenetic and found that the sexes occur in about equal numbers.[1] The data obtained on *Pseudococcus gahani* and on *Phenacoccus gossypii* show that these species also are non-parthenogenetic and have sex ratios approximating 0.5.

To determine the necessity of fertilization in the reproduction of these species, it was necessary to procure a stock of virgin females. This was accomplished without difficulty by rearing the mealybugs on clean, smooth potatoes having sprouts about one inch long and no cracks or rough places where a male might make its cocoon and escape detection. Eggs of approximately the same age were placed on the sprouting potatoes, which were then kept in glass jars covered with fine muslin. When the young bugs hatch they settle on the sprouts, where they develop with little or no migration until mature. The potato serves as a steady source of food, lasting a long time, and can be handled easily without disturbing the mealybugs.

In the life cycle of these mealybugs the males and females develop alike and without any apparent external difference until just prior to the second molt, when the males cease feeding and make cocoons in which they pupate and transform to winged adults. The females continue with incomplete metamorphosis, during the course of which they molt three times, oviposit, and die. To procure a stock of unfertilized females it was necessary to examine the bugs on the potato hosts daily under the low-power binocular microscope, and remove the males as they began their cocoons. Ultimately only unfertilized females were left.

[1]Myers (1932) also found that the sexes of *P. citri* occur in about equal numbers, but he states that the species reproduced parthenogenetically in his experiments.

Pseudococcus gahani.—In 1931 a good stock of virgin females was reared from eggs hatching about March 22. On April 28 a number of these mealybugs were already about 10 days beyond their normal time for oviposition but none showed any signs of laying eggs, although they became restless, left the sprouts, and wandered about in the jar. Twenty of these virgins were then transferred to individual glass containers and each provided with a small sprouting tuber to serve as food. Ten of these virgin females were kept unmated and ten were mated with males from another stock of mealybugs (Table I).

Although nearly all of the ten unmated mealybugs made more or less feeble attempts to make egg sacs, none was able to lay eggs. They lived many days beyond the normal length of life for the temperature at which they were kept and, with one or two exceptions, did not feed after they became full grown and began wandering about in the jar. It was plainly evident that something had disturbed the normal procedure of life. They were alive long after the mated females had oviposited and died.

All of the fertilized females produced eggs, with the exception of female No. 2. This female was mated at three different times and made several attempts to prepare an egg sac, but laid no eggs. Within two days, with few exceptions, the fertilized mealybugs had started egg sacs and laid their first eggs. Their egg masses were smaller than those under normal conditions, which was possibly due to delayed fertilization, since they were not mated until some time after they normally would have oviposited. Mating, as indicated by the life cycle, should occur after the third molt of the female. The eggs laid following the above matings hatched normally.

Newly-emerged males were placed with the females and the mating occurred while under observation with the low-power binocular microscope. The males, although they are small and delicate insects, are energetic and begin to seek the females shortly after emergence. During fertilization they remain in coition for a variable length of time, from a few minutes to an hour or longer. With the exception of Nos. 4 and 8, the males were removed immediately after copulation. That one male may fertilize more than one female is shown in Table I, where it is seen that mealybugs Nos. 3 and 4 were both mated to male *A*, and mealybugs Nos. 5, 6, and 7 were all mated to male *B*. Males are short-lived. Male *B* above and an unmated male each lived more than 25 and less than 40 hours after emergence.

General observations of heavy infestations of this species of mealybug convey the idea that there is no scarcity of males produced and that the sexes are about equal in numbers. The males migrate to the larger limbs and trunks of infested trees and make their cocoons before the females are half grown. In heavy infestations the male cocoons appear in great masses and their number has been used by field men as a relative index to the size of the brood. Men in charge of insectaries for the production of the ladybird beetle, *Cryptolaemus montrouzieri* Muls., are familiar with the enormous numbers of males that issue in the propagation rooms. In one brood of 180 *Pseudococcus gahani*,

TABLE I

Pseudococcus gahani. Mated and Unmated Females.
Hatched March 22. Sexually Mature (Estimated) April 18, 1931.

Number	Mated	Beginning Egg Sac	First Eggs Laid	Hatch Beginning	Adult Died	Length of Life (Days)
			Lot 1—Mated			
1	April 28	May 2	May 4	May 11	May 13*	52
2	April 28 May 8 May 13	May 9 May 14	None		June 9	99
3	April 28	April 30	April 30	May 11	May 13*	52
4	April 28	April 30	April 30	May 11	May 13*	52
5	April 28	April 30	April 30	May 11	May 13*	52
6	April 28	April 30	April 30	May 11	May 13*	52
7	April 28	April 30	April 30	May 11	May 13*	52
8	April 28	April 30	May 2	May 11	May 13*	52
9	April 28	April 30	May 1	May 11	May 13*	52
10	May 1	May 2	May 3	May 13	May 15*	54
			Lot 2—Unmated			
1		June 3†	None		June 22‡	92—
2		May 27	None		June 22‡	92—
3		June 22	None		June 29—	99—
4		June 3	None		June 22‡	92—
5		May 27	None		June 22‡	92—
6		June 3	None		June 22‡	92—
7		June 3	None		June 22‡	92—
8		None	None		June 22‡	92—
9		June 29	None		June 29+	99+
10		June 3	None		June 9—	79—

*Date of death estimated. The female mealybug usually dies shortly after the last eggs are laid. The first eggs are often hatching about the time the last ones are laid.

†Egg sacs begun by the unmated bugs were mostly only feeble attempts.

‡Death occurred between the observations of June 9 and June 22.

73 were males and 107 were females. These numbers are obviously inadequate for satisfactory determination of the sex ratio but there is no question that the number of males is sufficient in nature to fertilize all of the females.

Phenacoccus gossypii.—Only five virgin individuals of this species were reared (Table II). They were kept about a month beyond their normal time of sexual maturity, but none oviposited. Then two, Nos. 2 and 3, were mated, and these began their egg sacs on the following day and laid the first eggs on the second day after mating. The other three ultimately died without ovipositing. The normal longevity of these mealybugs was greatly increased. Mealybugs

TABLE II

Phenacoccus gossypii.

Mated and Unmated Females. Temperature 23° C.± 1932.

No.	Hatched	Sexually Mature*	Mated	Beginning Egg Sac	First Eggs Laid	First Eggs Hatched	Adult Died	Length of Life (Days)
1	Feb. 17	Mar. 9	No	No	None		April 16	59
2	Feb. 17	Mar. 9	April 11	April 12	April 13	April 23	April 27	70
3	Feb. 17	Mar. 12	April 11	April 12	April 13	April 23	April 27	70
4	Feb. 17	Mar. 7	No	No	None		April 11†	54
5	Feb. 17	Mar. 26	No	May 2	None		May 16	89
Normal Development at 23° C.±‡								
	Feb. 17	Mar. 7	Mar. 8±	Mar. 9	Mar. 10	Mar. 21	Mar. 25	37±

*They are sexually mature after the third molt.
†No. 4 was killed accidentally on April 11.
‡From a record of another brood reared at the same temperature.

Nos. 2 and 3 should have had a normal length of life of about 37 days, but fertilization was delayed about a month beyond their sexual maturity, hence they lived to 70 days.

In a total of 745 individuals, there were 403 males and 342 females, giving a sex ratio of 0.46.

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THE PRETARSUS (ARTICULARIS) IN COLEOPTERA[1]

WM. P. HAYES AND C. W. KEARNS,
University of Illinois

The number of tarsal segments (tarsomeres) in the legs of insects varies between one and five. Because many holometabolous insects exhibit five divisions of the tarsus, this number has usually been considered as primitive. Since paurometabolous insects, as a rule, have less than five segments it has been suggested that fewer than five segments might be the more primitive condition. Snodgrass (1927, p. 81) advanced the theory that "the *subsegments* or articles of the adult tarsus, conveniently called tarsal 'segments,' therefore appear to be subdivisions of a single primitive shaft; they have no articular hinges with each other, though they are usually freely movable by inflected connecting membranes and they never have individual muscles." He further indicates that tarsi with less than five segments represent "either a stage of progress in the division of the primitive, or a retrogressive condition in which some of the articles of a five-segmented tarsus have been lost or coalesced." The question of primitiveness is thus far from settled.

As long ago as 1740, Reaumur (p. 291) showed that in the tarsus of the honey bee there occurred a so-called "sixth tarsal segment" which bears the claws. Miall and Denny (1886, p. 61, footnote) state that Huxley (1878, p. 348, not 404) in his Anatomy of Invertebrate Animals points out that the so-called *puvillus* of the cockroach ought to be counted as a sixth joint and they further noted that "the same is true of the foot of Diptera and Hymenoptera, where there are six tarsal joints, the last carrying the claws."

This so-called sixth segment on the distal end of the tarsus was named the *praetarsus* by De Meijere (1901, p. 423), who considered it, not as a segment of the tarsus, but as an entirely independent leg structure. MacGillivray (1923, p. 246), objecting to the term pretarsus, asserted that it was a misnomer, and proposed the name *articularis* with the remark that "the

[1]Contributions from the Entomological Laboratories of the University of Illinois, No. 160.

articularis is in reality a posttarsus." He further points out that the greater part of this structure is retracted within the end of the distal tarsomere and is in great part concealed, "but is so far as observed always present." Other of the more important works discussing the structures distad of the fifth tarsomere (*distitarsus*) are those of Dahl (1884), Ockler (1890), Arnhart (1923), Crampton (1923), MacGillivray (1923), and Snodgrass (1927). In some of the earlier German works the pretarsus is called the "claw segment" (*Krallenglied*). Snodgrass (1927, p. 81) adopted De Meijere's name *praetarsus* in its Americanized form of *pretarsus*, "though not without regret that De Meijere did not invent a more fitting term." This spelling of "pretarsus" is adopted herein.

TERMINOLOGY

The distal tarsal segment has been called the *distitarsus* (Dt., Fig. 16). The term *onychium* has been used for it in certain Hymenoptera, but this name is loosely used for such structures as the *empodium* and *arolium*. Crampton (1923, p. 128) says it is "impossible to determine the original or most widespread use of the term *onychium*." Some workers have used the terms *digitus* and *ungula* for the *distitarsus*. Snodgrass (1927, p. 81) points out that there is no satisfactory name for the group of organs at the end of the tarsus "which in some cases might be termed the 'foot,' but not with those insects that place a part or all of the tarsus on the supporting surface."

In the usually accepted sense, the pretarsus includes the claws (Cla., Fig. 1) which are often termed the *ungues* (*ungula*, *unguicula* and *onychii*); a median padlike lobe which is known as the *arolium* (*ari-arolium* of MacGillivray) (ar., Figs. 3 and 10) and a pair of basolateral lobes associated with the underside of the claws called the *pulvilli*. The claws are hollow, many-celled structures that are articulated with the dorsal surface of the distitarsus by a structure termed the *unguifer* (*tubercula* of MacGillivray) (K., Fig. 3) which is a median process of the last tarsomere. The arolium is a membranous lobe that lies between the claws basally attached to the unguifer and may contain certain sclerotized (chitinized) areas. It is frequently incorrectly referred to as the empodium or pulvillus. Crampton (1923, p. 130) states that "the so-called pulvilliform empodium of certain Diptera . . . is probably an arolium, since it occupies the typical aroliar position between the claws and articulates dorsally with the unguifer, as does the arolium of lower insects." According to this and to statements of such writers as Snodgrass (1927, p. 83) and MacGillivray (1923, p. 248), the only place distal pulvilli occur is in the order Diptera. These are lateral, ventral lobes beneath the base of each claw. Certain Diptera (Tipulidae) have an arolium and two pulvilli, but according to Snodgrass (1927, p. 83) the arolium is absent or rudimentary in most Diptera.

In the membrane (coria) (M., Fig. 1) at the end of the distitarsus are a number of small chitinous sclerites which make up the pretarsus. They are subject to considerable variation. The dorsal and ventral aspects of a typical pretarsus are shown in Figures 3 and 10 which are taken from Snodgrass (1927, p. 82). A more complicated pretarsus has been described and figured by Arnhart (1923) for the honey bee. Snodgrass (1925, p. 97) has redescribed this type in his notable book on the Anatomy and Physiology of the Honey Bee. Since the pretarsus of Coleoptera differs from that of the bee and is more like the type which Snodgrass calls typical, a brief description of the typical form will be discussed here.

In the typical form (Fig. 3) and in Coleoptera there are no sclerotized areas on the dorsal aspect so that from above only a pair of claws (Cla.) and a central arolium (Ar.) are to be noted. Ventrally, in both Coleoptera and the typical form, is a large basal sclerite called the *unguitractor plate* (Utr., Fig. 10). Arnhart (p. 53) speaks of it as the *Stutzplatte* and MacGillivray (l. c., p. 248) has called it the *calcanea*, stating that "it is usually concealed externally for the most part through its retraction into the distal end of the distal tarsal segment." Attached to its proximal end is a long flexor, or retractor "tendon" which operates, according to Crampton and Snodgrass, the claws and according to MacGillivray the entire pretarsus. This so-called tendon has been called the *unguitractor tendon* (Utr. T., Fig. 10) by Crampton (l. c., p. 30). MacGillivray named it the *aratendon* and European writers speak of it by the German name "*Sehne*," meaning a tendon. MacGillivray states that this tendon is long and slender and extends through the tarsus and tibia. Snodgrass (1927, p. 89) figures this tendon as ending in the tibia. In the present study of the pretarsus in Coleoptera, the writers have traced it (Fig. 2) through to the trochanter. At various regions, in both the femur and tibia, muscles are to be noted attached to this long tendon which are fastened at their other end to the wall of the appendage.

Crampton (1923, p. 130) asserts that "the true *empodium* is a process of the unguitractor and points out that "many heterogeneous structures pass under the name 'empodium,' but the true empodium is a process of the unguitractor plate" and that the "unguitractor frequently bears apical setae which may be called *parempodia* or unguitractor setae." This process of the unguitractor (Emp., Fig. 1) is called an *onychium* by MacGillivray (1923, p. 249) who states, "There is absolutely no reason for considering the empodium and onychium as homologous structures. An onychium is also present in certain beetles, where it may be of considerable length and bears long setae at its distal end. In the Coleoptera these setae are known as the paronychium." He also describes the empodium as a cushionlike pad located between the pulvilli. It is similar in form and structure to the pulvilli and in many flies is reduced to a mere knob bearing setae. Snodgrass (1927, p. 83) writes " a median process, the *empodium* . . . , or 'process plantaris' of De Meijere, is commonly developed from the distal end of the unguitractor plate." In view of the conflicting terminology for these parts,

the writers do not adopt MacGillivray's terms because, as pointed out above, the term onychium is not used uniformly and may apply to entirely different structures. The term empodium (Emp., Fig. 1) is likewise unsatisfactory, but will be used here to designate the distal prolongation of the unguitractor. The setae sometimes occurring on the end of the empodium will be designated by Crampton's term, *parempodia* (Pmp., Fig. 1) instead of paronychii. Ockler (1890) and other foreign writers have regarded these setae as taste hairs (*Tasthaare*).

THE UNGUITRACTOR OF THE PRETARSUS

The rather striking degrees of difference in the form of the unguitractor and its processes in Coleoptera have not been described. Scattered throughout the literature are a few figures showing its shape in certain species. De Meijere (1901, Plate 32) has shown illustrations of a few species of beetle pretarsi (e. g., *Sitona*, *Meloe* and *Dytiscus*). In only one of these (Sitona) does he show any detail. Dahl (1884, Plate XI) has shown the structure in cross and longitudinal section. Ockler (1890) has illustrated less than a dozen genera including Dytiscus, Melolontha, Hydrophilus, Carabus, Meloe, and Oryctes.

In general it may be said that within some species there is but slight difference in form of the unguitractor of the various tarsi. Others show sexual differences, particularly in the pro- and metathoracic tarsi. In Hydrophilus the unguitractor of the male propretarsus (Fig. 19) differs markedly from that of the male metapretarsus (Fig. 17). In the female all tarsi resemble the metatarsi of the male. There are instances also, as for example, in Dytiscidae, where the modified, natatorial metatarsus bears but one claw and consequently has no development of a pretarsus, while the pro- and mesotarsi have two claws and a normal development of the pretarsus.

Two distinct general types of unguitractor are present in the Coleoptera, the most common of which is that in which the unguitractor is attenuated distally into a variously shaped, so-called empodium which may or may not be provided with two or more parempodia (Figs. 4 and 19). A second type (Figs. 12 and 13) is a more or less ovate or pyriform unguitractor without a distally attenuated empodium. Both of these types are provided with a long unguitractor tendon.

The ventral surface (Fig. 6) of the unguitractor is covered with variously shaped cuticular outgrowths in the form of small nodules which, when arranged together and viewed under lower powers of magnification, produce a series of diagonal striations converging disto-mesad. These structures produce a serrate, lateral margin (Fig. 23) in many species and give to all a shagreened or rugose surface which apparently serves for traction.

There is some evidence to believe that in the type which bears an empodium that the empodium is capable of being extended or retracted within the unguitractor. Some cleared specimens show what appears to be a basal part of the empodium withdrawn into the body of the unguitractor (Fig. 31).

Obviously, the writers have been able to examine the pretarsus of but only a few representative beetles. It is, therefore, proposed to describe the unguitractor and its associated parts in those superfamilies in which specimens were examined. Since there seem to be noteworthy differences in some genera within a designated family, it is deemed advisable to consider representative species studied in the larger groups which are designated as series or superfamilies in Leng's check list (1920).

Suborder Adephaga

Caraboidea.—Two species of Carabidae, *Calosoma calidum* Fab. (Fig. 6) and *Harpalus caliginosus* (Fab.) (Fig. 5), *Cicindela punctulata* Oliv. (Fig. 4) of the Cicindelidae and *Dytiscus fasciventris* Say (Fig. 7) of the Dytiscidae were examined. All of these are of the same general type in which the unguitractor is prolonged into an empodium without parempodia. The shape of the unguitractor varies from broadly ovate (Fig. 6) to shield-shaped (Fig. 7). The empodium is either fusiform (Fig. 6) or clavate (Fig. 4), being broadly so in *Harpalus* (Fig. 5). In *Dytiscus* (Fig. 7) it is slightly broader near the middle and somewhat tapering toward the end. Ockler's figure (Plate 12, Fig. 32) of *Dytiscus marginalis* L. shows it to be similar to that of *D. fasciventris* Say examined by the writers. However, Ockler's figure of the genus Carabus (*l. c.*, Plate 13, Fig. 48) shows it to be different from *Harpalus* and *Calosoma* in that the empodium possesses two parempodia.

Gyrinoidea.—In *Dineutes americanus* Say. (Figs. 8 and 9) one specimen was examined in which no empodium was present. The unguitractor is pointed to give the whole a somewhat pear-shape when viewed from beneath, while a lateral view (Fig. 9) shows the sides and tip to be strongly inflexed to make a strong emergination between the middle and the tip.

Suborder Polyphaga

Hydrophiloidea.—In *Hydrous triangularis* (Say) the sclerite of the pretarsus differs in the sexes in that two parempodia are present on the empodia of all three tarsi in the female, while in the male the front tarsus has an empodium with six parempodia (Fig. 19) and the meso- and metatarsal empodia have but two parempodia (Fig. 17). The unguitractor of the fore tarsus of the male is broadly oval with its distal end truncate. In the metatarsus it is much narrower and its distal end is deeply incised and bears at the bottom of the incision a short empodium. The empodium of the fore tarsus is twice as long as the unguitractor and gradually clavate. The metatarsal empodium is shorter than the unguitractor and more oval in shape. Its two parempodia are about three times as long as the unguitractor. In the related species, *Diboloceius ovalis* Ziegl., the parempodia are two and four instead of two and six as above. Ockler (*l. c.*) figures two views of *Hydrophilus aterrimus* Esch. in which the empodium shows two groups of five parempodia, or ten in all. He does not state to which tarsus these belong. In all probability, they are from the fore tarsi of the male. Simmermacher (1884, Plate 27, Fig. 41) illustrated the

unguitractor with its empodium and tendon of *Hydrophilus piceus* Linn. He does not indicate to which leg it belongs. The drawing shows nine parempodia which are called by Simmermacher, the *Tastborsten*, or taste bristles.

Silphoidea.—In *Silpha surinamensis* (Fab.) (Fig. 37), and *S. americana* Linn. (Fig. 38), the metathoracic pretarsus shows the unguitractor to be shield-shaped, with its distal margin subtruncate and its proximal margin more rounded. The empodium is somewhat capitate and slightly shorter than the length of the unguitractor. It bears two parempodia which are slightly longer than the length of the empodium. This corresponding structure in the legs of *S. americana* (Fig. 38) is similar to *S. surinamensis* (Fig. 37). Ockler (*l. c.*, Fig. 65) has figured the unguitractor of *Silpha thoracica* Linn., which is quite similar to that described above.

Staphylinoidea. — The unguitractor of the prothoracic leg of *Creophilus maxillosus* (L.), (Fig. 25) is like that of *Silpha* in general shape, but differs in having a much shorter and stubbier empodium that bears two parempodia which arise in two conspicuous trichophores near its distal end. The parempodia are several times longer than the empodium. Ockler (*l. c.*, Fig. 30) in a longitudinal section of *Pselaphus Heisii* Herbst. shows this species to have an empodium but parempodia are not present in his drawing.

Cantharoidea.—Two species in two families of this group show wide differences. In the Cleridae, the unguitractor of *Trichodes apivorus* Germ. (Fig. 23) is nearly shield-shaped with the empodium slightly shorter than the unguitractor. It is only slightly clavate and its entire length bears rather long setae, while its distal end is provided with two parempodia. In the Corynetidae, the middle pretarsus of *Necrobia rufipes* (De G.) (Fig. 32) shows the unguitractor to be slightly attenuated distally and then cut off diagonally. Distad of and surrounding the sides of this apparently abbreviated empodium is a broad membranous-like structure that is strongly rounded on its distal margin. Ventrally, near the distal end are two short, diverging parempodia. This membranelike process is reminiscent of the sclerite called the planta as found in the honey bee.

Cupesoidea.—This superfamily is composed of but one family, the Cupesidae, which includes but two genera, one of which was examined. The prothoracic leg of *Cupes capitatus* Fab. (Fig. 42) shows the pretarsus to contain a pear-shaped unguitractor that lacks an empodium which is apparently replaced by a short clump of distally directed setae on the distal margin of the unguitractor.

Mordelloidea.—The tarsi of five families in this group were examined. In the Cephaloidae the pretarsus of the first leg of *Sponidium tenuicorne* (Lec.) (Fig. 31) shows the unguitractor to be oblong-oval in form with the distal end acutely emarginate. From the bottom of this emargination arises the empodium which is clavate and appears to be articulated with the unguitractor by a membranous connection. It is somewhat setose, especially near the base and bears two parempodia that arise some distance from the tip end. The empodium is about as long as the unguitractor.

The unguitractor of the anterior tarsus of *Ditylus quadricollis* Lec. (Fig. 22) in the family Oedemeridae is almost circular in form. The empodium about equals in length the diameter of the unguitractor and is oblong-oval in form. Near its base are some long setae and two parempodia arise near the middle of the empodium. In the metathoracic leg (Fig. 21) the unguitractor is more nearly quadrate and empodium is somewhat shorter.

In the Mordellidae, *Mordella octopunctata* Fab. (Fig. 18) has a broadly oval unguitractor from which the empodium arises without the usual well marked constrictions. No parempodia are present but the empodium from base to tip is covered with dense spinose setae.

Two genera of Meloidae were examined. The metathoracic pretarsus was found to be quite similar in form in *Macrobasis unicolor* (Kby.) (Fig. 28) and *Epicauta cinerea* (Forst.) but *Epicauta* is larger. In *Epicauta* (Fig. 27) the unguitractor is broadly oval and slightly emerginate distally at the point where the fusiform empodium arises. The length of the empodium is slightly greater than the length of the unguitractor. Three parempodia extend from the distal end of the empodium. They are arranged at their base somewhat in the manner of a tripod. Ockler (*l. c.*, Fig. 50) shows the unguitractor of *Meloe proscarabaeus* Leach to have a short empodium which is devoid of parempodia.

In the family Pyrochroidae, the pretarsus of the front leg of *Neopyrochroa flabellata* Fab. (Fig. 1) was studied. The empodium is remarkably like that of Ditylus in the Oedemeridae with two parempodia located near its middle line. The unguitractor differs in being slightly longer than the empodium and more narrowly oval in form.

Elateroidea.—The Rhipiceridae as represented by *Sandalus niger* Koch (Figs. 16 and 33), the Elateridae by *Alaus oculatus* (Linn.) (Fig. 41) and the Buprestidae by *Buprestis decora* (Fab.) (Fig. 36) were examined in this group. All three of these differ widely in the form of the pretarsus. In Sandalus (Fig. 33), the unguitractor has its lateral margins nearly parallel and its distal margin is acutely and deeply incised. The empodium is nearly twice as long as the unguitractor, somewhat curved and covered with long setae on its distal half, while the basal half bears numerous short setae. No parempodia are present.

In *Alaus oculatus* (Linn.) (Fig. 41) the unguitractor is somewhat pentagonal in form. The empodium is spindlelike, being broader near its middle. Two parempodia are located near the end of the empodium. The unguitractor in Buprestis (Fig. 36) is small and somewhat pear-shaped. No empodium or parempodia are present. At the narrowed distal end of the unguitractor is a group of short setae. The lack of empodium and parempodia is similar to the condition found in some Rhynchophora such as Rhynchites (Fig. 12), Eupsalis (Fig. 14), in the Chrysomelidae (Fig. 13) and Coccinellidae (Fig. 11).

Byrrhoidea.—The pretarsus of the metathoracic leg of *Dermestes caninus* Germ. (Fig. 24) has an unguitractor that has the pentagonal form of *Alaus*. The empodium is slightly constricted basally, but of a

somewhat uniform, clavate shape. It is covered throughout its length with short setae and two parempodia are present.

Cucujoidea.—Of the 18 families listed in this group by Leng (1920) only the Coccinellidae have been examined by the writers. In the metathoracic leg of *Epilachna corrupta* Muls. (Fig. 11), the unguitractor alone is present. It is elongate-oval in form but slightly truncate at its tip where a few short setae are grouped together.

Tenebrionoidea.—Two families examined in this superfamily show marked differences. In the Tenebrionidae, three species of Eleodes were examined, *E. opaca* (Say), *E. suturalis* (Say), and *E. tricostata* (Say). All are quite similar. The unguitractor is broadly oval and the clavate empodium is slightly longer than the unguitractor. It is provided with two parempodia which arise near the distal end. These are to be illustrated in a forthcoming thesis by the junior author on the Morphology of Eleodes.

In *Platydema ruficorne* Sturm. (Fig. 20) as compared to Eleodes, the unguitractor is more narrowly oval and the empodium is more capitate than clavate. The distal end is truncate and near the base of the club are two parempodia which project beyond the end of the empodium. The basal insertion of the parempodia is similar to that found in Dytilus in the Oedemeridae.

Scarabaeoidea.—Specimens of three families, Scarabaeidae, Lucanidae and Passalidae, were examined in this superfamily. In the Scarabaeidae, *Ligyrodes relictus* (Say) (Fig. 29) has the unguitractor gradually narrowed at its distal margin to produce a long clavate empodium with two parempodia. A quite similar condition exists in *Cotinus nitida* (Linn.) (Fig. 34) in which two parempodia are present, but the empodium is gradually bent as described below for the Lucanidae. All three pairs of tarsi of *Phyllophaga futilis* (Lec.) (Fig. 39) show a condition that is similar to Ligyrodes. The curvature of the empodium as in *Cotinus* is not present.

Ockler's drawing of *Oryctes nasicornis* Westw. (*l. c.*, Fig. 62) shows a long, clavate empodium attached to the unguitractor with its terminal end provided with eight parempodia. The empodium is bent gradually to form an archlike curvature similar to what the writers have found in *Pseudolucanus*, Lucanidae (Fig. 35) and which will be described below. Ockler's Figure 47 of *Anisoplia horticola* Fab. shows a slightly bent empodium with but two parempodia and his Figure 9 of *Melolontha vulgaris* Linn. is of the same general type. De Meijere (*l. c.*, Fig. 46) figures *Hoplia coerulea* Drur. in side view. It apparently has no empodium.

In the Lucanidae, the unguitractor of *Pseudolucanus dama* (Fab.) (Fig. 40) is somewhat pentagonal and the empodium is much longer than the unguitractor and of quite uniform width. A side view (Fig. 35) shows the empodium to be strongly bent as in *Cotinus* and *Oryctes*, noted above. There are six parempodia located on the end of the empodium which are shorter than the empodium.

The unguitractor of *Passalus cornutus* Fab. (Fig. 30) of the Passalidae is somewhat diamond-shaped. It is produced into an empodium, about

equal to its own length, which is slightly constricted near its base and on its distal end attenuated to a sharp point. Two parempodia are located near the end. Their origin is on each side of the pointed end. The length of the parempodia is about equal to the combined length of the unguitractor and the empodium.

Cerambycoidea.—Two of the three families in this group were examined. In each family but one specimen was studied. They are noteworthy in the lack of parempodia, but each has a different empodium. In the Cerambycidae, *Monochamus maculosus* Hald. (Fig. 15) the unguitractor is strongly pyriform with its distal end attenuated into a narrow empodium that is entirely covered with short setae. No parempodia are present. In the Chrysomelidae, the unguitractor of *Leptinotarsa decemlineata* (Say) (Fig. 13) is likewise pyriform. Its end is constricted into a short empodium without short setae or parempodia.

Brentoidea.—The pretarsus of *Eupsalis minuta* Drury (Fig. 14) is similar to some of the Adephaga above. No parempodia are present. The unguitractor is broadly oval, truncate, distally, and the empodium is shorter than the unguitractor and somewhat pointed.

Curculionoidea.—*Rhynchites bicolor* Fab. (Fig. 12) and *Hypera punctata* (Fab.) (Fig. 26) are strikingly different in the form of the pretarsus. *Rhynchites* has a simple pyriform unguitractor that is slightly pointed on its distal end, giving it the appearance of that which has just been described above for *Eupsalis minuta.* Hypera is different in that the distal end is more elongated to form an empodium which is provided with two parempodia. De Meijere (*l. c.*, Fig. 51) has shown the unguitractor of *Sitona lineatus* L. to be without an empodium but in its place are two parempodia that arise from lateral prolongations of the unguitractor and not from the empodium.

SUMMARY.

The primitive number of tarsomeres of the leg of insects may be one or five. There is argument for either condition. A so-called sixth tarsomere known as the pretarsus exists in many species but is usually overlooked or disregarded in morphological descriptions. In the honey bee and others it consists of a number of sclerotized areas located in the membrane at the base of the claws. In the Coleoptera there is a reduction in the number of sclerotized parts, in which the number of sclerites is reduced to a single ventral plate, known as the unguitractor plate, which may be produced distally into an empodium. This, in turn, may have at its distal end setal processes known as parempodia.

From this study it is apparent that beetles have two types of pretarsi. One in which the unguitractor plate bears an

empodium and another in which the unguitractor lacks an empodium. In those with an empodium, two subtypes may be recognized, one in which the empodium bears from two to many parempodia and another in which parempodia are lacking. The species examined in the suborder Adephaga seem to be the only group showing any consistency in structure. Here is found the empodial type in which the parempodial processes are absent. In the suborder Polyphaga no such consistency occurs. Sexual differences may be found in certain species and individuals of other species may show differences in the fore and hind tarsi. In some there is a tendency toward generic or family uniformity but superfamilies are decidedly heterogeneous. There is need for further study within groups to determine the value of this character for taxonomic use.

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EXPLANATION OF PLATES

PLATE I

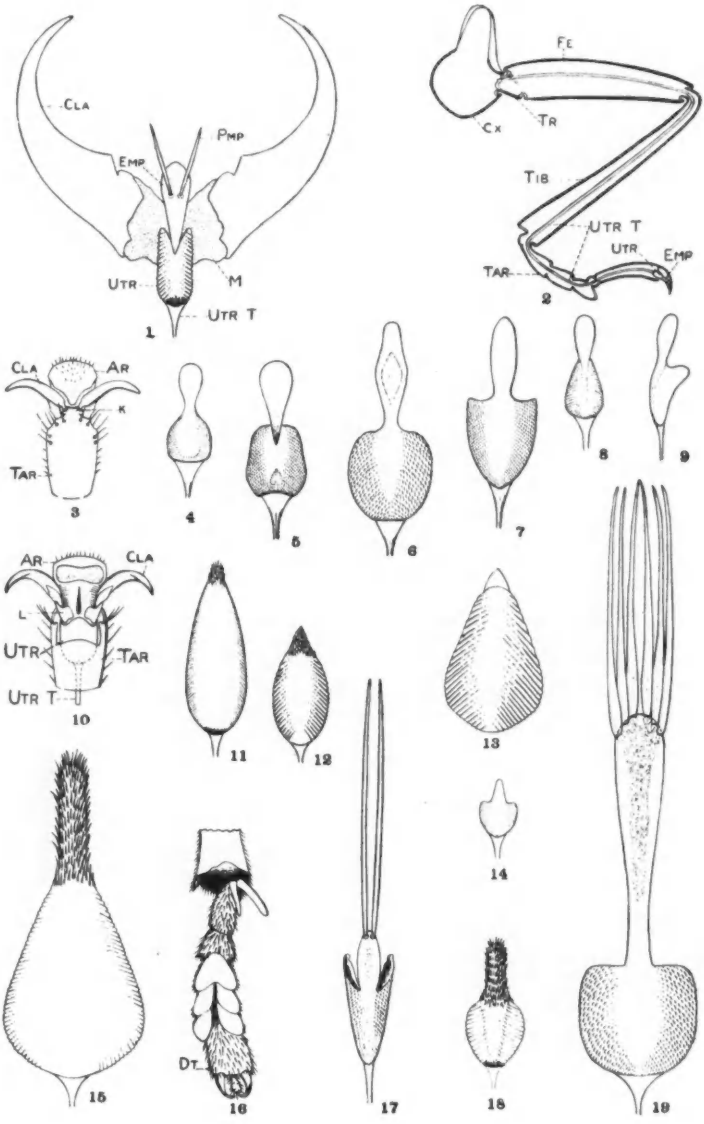
Fig. 1, *Neopyrochroa flabellata* Fab. Claws and pretarsus. 2, *Ergates spiculatus* Lec., showing unguitractor tendon. 3, Typical pretarsus, dorsal aspect. After Snodgrass. 4, *Cicindela punctulata* Oliv. Cicindelidae. Propretarsus. 5, *Harpalus caliginosus* (Fab.) Carabidae. Metapretarsus. 6, *Calosoma calidum* Fab. Carabidae, Metapretarsus. 7, *Dytiscus fasciventris* Say, Dytiscidae, Propretarsus. 8, *Dineutes americanus* Say. Dytiscidae, ventral aspect. 9, *Dineutes americanus* Say. Dytiscidae, Lateral aspect. 10, Typical pretarsus, Ventral aspect. After Snodgrass. 11, *Epilachna corrupta* Muls. Coccinellidae, Metapretarsus. 12, *Rhynchites bicolor* Fab. Curculionidae, Metapretarsus. 13, *Leptinotarsa decemlineata* (Say) Chrysomelidae, Metapretarsus. 14, *Eupsalis minuta* Drury. Brentidae, Propretarsus. 15, *Monochamus maculosus* Hald. Cerambycidae, Mesopretarsus. 16, *Sandalus niger* Knoch. Rhipiceridae, Protarsus. 17, *Hydrous triangularis* (Say). Hydrophilidae, Metapretarsus of male. 18, *Mordella octopunctata* Fab. Mordellidae, Metapretarsus. 19, *Hydrous triangularis* (Say). Hydrophilidae, Propretarsus of male.

PLATE II

Fig. 20, *Platydema ruficorne* Sturm. Tenebrionidae, Metapretarsus. 21, *Ditylus quadricollis* Lec. Oedemeridae, Metapretarsus. 22, *Ditylus quadricollis* Lec. Oedemeridae, Propretarsus. 23, *Trichodes apivorus* Germ. Cleridae, Propretarsus. 24, *Dermestes caninus* Germ. Dermestidae, Metapretarsus. 25, *Creophilus maxillosus* (L.). Staphylinidae, Propretarsus. 26, *Hypera punctata* (Fab.) Curculionidae, Metapretarsus. 27, *Epicauta cinerea* (Forst.) Meloidae, Metapretarsus. 28. *Macrobasis unicolor* (Kby.) Meloidae, Metapretarsus. 29, *Ligyrodes relictus* (Say). Scarabaeidae, Metapretarsus. 30, *Passalus cornutus* Fab. Passalidae, Metapretarsus. 31, *Sponidium tenuicorne* (Lec.) Cephaloidae, Propretarsus. 32, *Necrobia rufipes* (DeG.) Corynetidae, Mesopretarsus. 33, *Sandalus niger* Knoch. Rhipiceridae, Propretarsus. 34, *Colinus nitida* (Linn.) Scarabaeidae, Propretarsus. 35, *Pseudolucanus dama* (Fab.) Lucanidae, Propretarsus, lateral aspect. 36, *Buprestis decora* (Fab.) Buprestidae, Metapretarsus. 37, *Silpha surinamensis* (Fab.) Silphidae, Metapretarsus. 38. *Silpha americana* Linn. Silphidae, Mesopretarsus. 39, *Phyllophaga futilis* (Lec.) Scarabaeidae, Metapretarsus. 40, *Pseudolucanus dama* (Fab.) Lucanidae, Propretarsus, ventral aspect. 41, *Alaus oculatus* (Linn.) Elateridae, Mesopretarsus. 42, *Cupes capitatus* Fab. Cupesidae, Propretarsus.

LIST OF ABBREVIATIONS USED IN PLATES

Ar.—arolium.
Cla.—claw.
Cx.—coxa.
Dt.—distitarsus.
Emp.—empodium.
Fe.—femur.
K.—unguifer.
L.—auxiliary plate.
M.—membrane.
Pmp.—parempodium.
Tar.—tarsus.
Tib.—tibia.
Tr.—trochanter.
Utr.—unguitractor plate.
Utr. T.—unguitractor tendon.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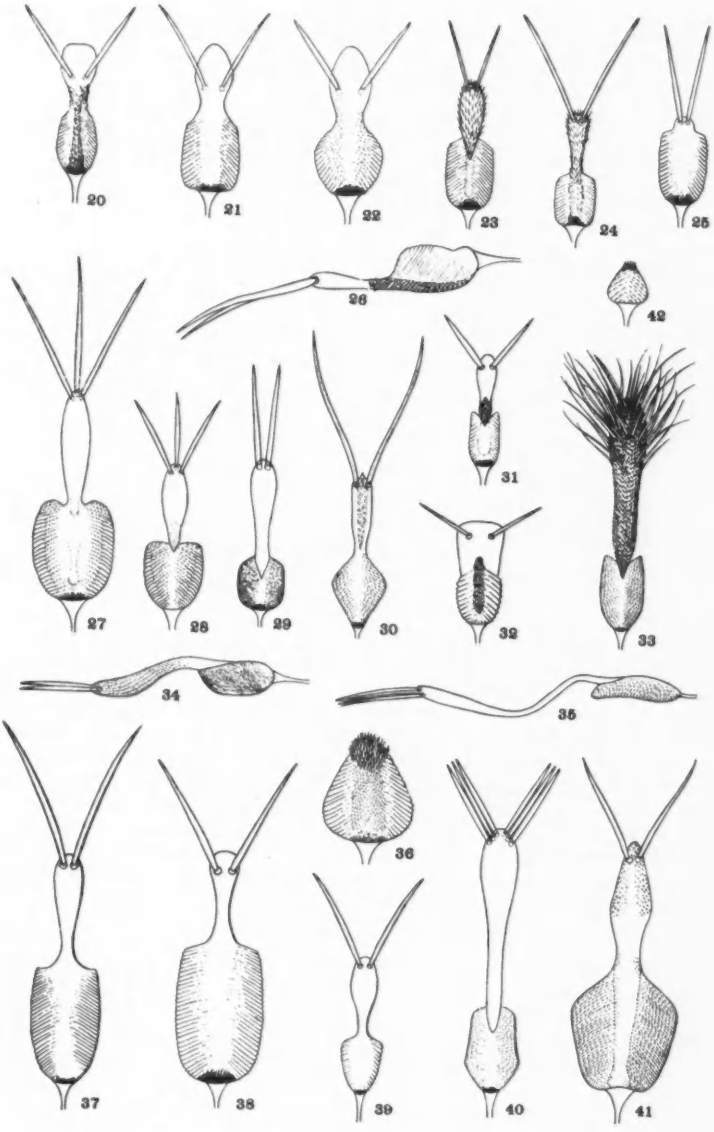
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FOUR NEW PEMPHIGIDS FROM COLORADO

(Aphidae: Homoptera)

ASA C. MAXSON

Pemphigus juncti-sensoriatus n. sp.

(Fig. 1.)

Fundatrix.

Color: General color pale yellowish white. Front, vertex and lateral margins of prothorax brownish. Near posterior margin of head the brownish color broken and interspersed with lighter areas of same color as prothorax. Ocular tubercles dark brown. Segments I and II of antennae brownish; I the darker. The distal quarter of III and all of IV brownish. Legs and coxae brownish; tarsi darker than tibiae. Segments II and III of beak and clypeus brownish; tip of beak dark brown.

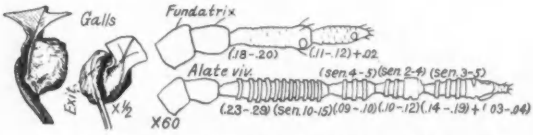

FIG. 1. *Pemphigus juncti-sensoriatus*, n. sp.

Measurements: Length, 3.40 mm.; width, 2.6 mm.; Fore femora, 0.41 mm.; tibiae, 0.29 mm.; tarsi, 0.12 mm. Middle femora, 0.41 mm.; tibiae, 0.36 mm.; tarsi, 0.12 mm. Hind femora, 0.60 mm.; tibiae, 0.52 mm.; tarsi, 0.15 mm. Antennae, I, 0.08 mm.; II, 0.08 mm.; III, 0.19 mm.; IV, 0.13 mm.

Structural characters: Antennae 4-jointed. Segment III slightly swollen distally; greatest diameter of IV about two-thirds of distance brom base to tip. Spur short but distinct. Permanent sensoria near distal end of III and at base of spur on IV; surrounded by cilia; IV and distal portion of III weakly imbricated. Eyes composed of 3 facets. Wax pores on thoracic segments and segments I to VII of abdomen; surrounded by distinct chitinous rings. Facets numerous, irregular in form but quite uniform in size.

Described from morphotype taken with fundatrigenia described below.

Fundatrigenia.

Color: Living insect with a bluish tinge after exposure to the light; covered with a fine whitish powder or cottony secretion. Head and thorax dark, almost black. Abdomen yellowish or yellowish green. Antennae dusky except at base of III and tissue connecting segments.

Legs dusky; distal half of femora distal portion of tibiae, and tarsi darker than remaining parts of legs. Costal and subcostal veins of fore wings dusky. Stigma with dusky band on posterior margin broadening to about one-quarter the length of stigma, at its tip.

Measurements: Length, 1.6 mm. (1.4 to 1.8 mm.). Fore femora, 0.51 mm. (0.47 to 0.52 mm.); tibiae, 0.57 mm. (0.52 to 0.59 mm.); tarsi, 0.16 mm. (0.15 to 0.16 mm.). Middle femora, 0.40 mm. (0.36 to 0.41 mm.); tibiae, 0.55 mm. (0.53 to 0.56 mm.); tarsi, 0.17 mm. (0.16 to 0.17 mm.). Hind femora, 0.54 mm. (0.48 to 0.55 mm.); tibiae, 0.74 mm. (0.70 to 0.75 mm.); tarsi, 0.19 mm. (0.17 to 0.19 mm.). Antennae; I, 0.07 mm.; II, 0.07 mm.; III, 0.26 mm. (0.24 to 0.27 mm.); IV, 0.10 mm. (0.09 to 0.10 mm.); V, 0.11 mm. (0.11 to 0.12 mm.); VI, 0.18 mm. (0.17 to 0.19 mm.).

Structural characters: Antennae 6-jointed; secondary sensoria variable in form; not encircling the joints; width very variable; prominently raised above surface of joints; surface flat or but very slightly convex. Sensoria on III, Right, 12; Left, 11 (10 to 14). Sensoria often united; V- or Y-shaped or united for varying distance at the center leaving only tips to indicate the number involved. IV, R, apparently 4, the basal pair united except at tips; the distal pair forming a Y; L, 4; V, R, basal pair not united; distal half of joint covered by a large, irregularly shaped sensorium apparently composed of at least 3 sensoria united; surface with 1 chitinous island; L, similar to R except that there are 2 chitinous islands on the distal sensorium each with 2 small bristles. VI, R, basal half with one small oval and 1 very broad sensorium, distal half covered by a large irregular sensorium with one chitinous island; L, basal one-half with 3 broad sensoria, distal half with 2 broad sensoria the outer one irregular in form, the inner composed of at least two sensoria united. The outer sensoria on VI extending up onto the base of the spur. Permanent sensoria on V and VI surrounded by secondary ones so as to be hardly visible. The number of sensoria united and the degree to which they are united is very variable.

Described from holotype and 18 paratypes from same gall as holotype. Host, *Populus deltoides*.

The Gall.

A more or less globular gall located at the base of the leaf composed of leaf blade and petiole. That part consisting of leaf blade is somewhat oval, very much thickened, and more or less convex. The leaf margins can be traced along the edges of this thickened portion for some distance. The greater part of the gall is composed of a very much widened, thickened and twisted portion of the petiole. The opening is long, passing more than half way around the gall. The mouth is loosely closed and lacks the small, round orifice found in the galls of *Pemphigus populi-caulis*.

Taxonomy.—This species is close to *populi-caulis* but differs from it in having the greater part of the gall composed of petiole

instead of leaf blade as in the latter and in having many of the secondary antennal sensoria of the fundatrigenia coalescent.

Types in U. S. Nat. Mus., Cat. No. 50063; paratypes in author's collection.

Pemphigus nortonii, n. sp.

(Fig. 2.)

Fundatrix.

Color: Head brown with a pale median line. Ocular tubercles brown. Legs, pale brown; tarsi and tips of tibiae darker. Clypeus, 2nd and 3rd joints of beak, 1st and 4th joints of antennae pale brown. Tip of beak dark brown.

Measurements: Length, 2.60 mm. (2.50 to 2.60); width, 1.75 mm. (1.74 to 2.00 mm.); fore femora, 0.38 mm. (0.38 to 0.40 mm.); tibiae, 0.31 mm. (0.27 to 0.31 mm.); tarsi, 0.11 mm. (0.11 to 0.12 mm.); middle femora 0.39 mm. (0.35 to 0.39 mm.); tibiae 0.33 mm. (0.29 to 0.33 mm.); tarsi, 0.12 mm. (0.12 to 0.13 mm.); hind femora, 0.52 mm. (0.50 to 0.52 mm.); tibiae, 0.50 mm. (0.47 to 0.50 mm.); tarsi, 0.14 mm. Antennae, I, 0.09 mm. (0.07 to 0.09 mm.); II, 0.09 mm. (0.07 to 0.09 mm.); III, 0.16 mm. (0.14 to 0.16 mm.); IV, 0.14 mm. (0.13 to 0.14 mm.).

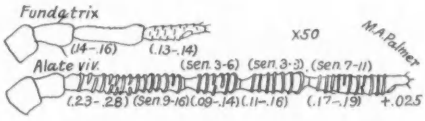

FIG. 2. *Pemphigus nortonii*, n. sp.

Structural characters: Antennae, 4-jointed. Spur on IV short and indinstinct. Permanent sensoria at base of spur on IV and near distal end of III; surrounded by cilia. Sensoria on IV larger than on III; surrounded by more strongly developed cilia. Three small sensoria near principal one on IV also surrounded by cilia. Segment IV almost cylindrical; at most but slightly thickened near tip; its greater diameter less than that of III. Segments III and IV distinctly imbricated; IV most strongly. Eyes composed of 3 facets. Wax glands well developed on thorax and segments I to VII of the abdomen; surrounded by a distinct chitinous ring. Facets small, numerous, irregular in form; quite uniform in size. Usually a curved hair on surface of glands.

Described from morphotype taken with holotype described below and two morphotypes taken July 2, 1929.

Fundatrigenia.

Color: Living insect with a bluish tinge after exposure to the light; covered with a fine whitish powder or cottony secretion. Head and thorax dark, almost black, abdomen yellowish or yellowish green.

Antennae dusky, darker than legs. Legs dusky; tips of segments and tarsi darkest. Costal and subcostal veins dusky; posterior margin of stigma with a dark band which is broadest at tip of stigma. Other veins slightly dusky.

Measurements: Length, 1.68 mm. (1.53 to 1.84 mm.); fore femora, 0.50 mm. (0.42 to 0.50 mm.); tibiae, 0.59 mm. (0.49 to 0.59 mm.); tarsi 0.15 mm. (0.14 to 0.15 mm.); middle femora, 0.48 mm. (0.32 to 0.48 mm.); tibiae, 0.58 mm. (0.48 to 0.58 mm.); tarsi, 0.15 mm. (0.14 to 0.15 mm.); hind femora, 0.56 mm. (0.39 to 0.56 mm.); tibiae, 0.73 mm. (0.61 to 0.73 mm.); tarsi, 0.17 mm. (0.16 to 0.17 mm.). Antennae, I, 0.07 mm.; II, 0.07 mm.; III, 0.27 mm. (0.23 to 0.28 mm.); IV, 0.14 mm. (0.09 to 0.14 mm.); V, 0.15 mm. (0.11 to 0.16 mm.); VI, 0.20 mm. (0.17 to 0.22 mm.).

Structural characters: Antennae, 6-jointed; III to VI, annular. Secondary sensoria narrow, almost encircling the joints. Sensoria on III, 15 (9 to 16); IV, 6 (3 to 6); V, 7 (3 to 8); VI, 11 (7 to 11). Fore wing with M simple; basal third obsolete. First and second diagonals with bases well separated. Stigmal vein curved. Diagonals of hind wing with bases normally well separated. Wax glands on abdomen weakly developed; absent on thorax. Cornicles normally absent; when present, reduced to wealky developed circular pores. Rudimentary gonapophyses 3.

Described from holotype and 18 paratypes from galls taken on *Populus deltoides* at Wheatland, Wyoming, August 2, 1924, and July 2, 1929.

Galls: The galls are similar to those of *Pemphigus populi-caulis*.

Taxonomy.—This species is most closely related to *Pemphigus populi-caulis*, differing from it mainly in having the antennae longer in proportion to the hind tibiae and a greater number of secondary sensoria on joints III to VI of the fundatrigenia.

Types in U. S. Nat. Mus., Cat. No. 50064; paratypes in author's collection.

Pemphigus monophagus, n. sp.

(Fig. 3.)

Fundatrix.

Color: Head brown; darkest on front; a faint, pale median line. Antennal segments brownish; I and II darkest. Legs light brown; tips of tibiae and tarsi darker. Clypeus and 2nd and 3rd joints of beak brownish; tip dark brown. Body very pale olive green to whitish.

Measurements: Length, 1.70 mm. Antennae; I, 0.05 mm.; II, 0.05 mm.; III, 0.08 mm.; IV, 0.09 mm. Fore femora 0.22 mm.; tibiae, 0.20 mm.; tarsi, 0.10 mm. Middle femora, 0.23 mm.; tibiae, 0.20 mm.; tarsi, 0.10 mm. Hind femora, 0.29 mm.; tibiae, 0.22 mm.; tarsi, 0.11 mm.

Structural characters: Antennae, 4-jointed; IV the longest. Spur of IV short but distinct. Permanent sensoria at base of spur on IV and near distal end of III; surrounded by cilia; sensorium on IV the largest. Segment IV distinctly imbricated. Eyes composed of 3 facets. Wax pores: 4 in a line on prothorax; 6 on remaining thoracic segments and abdominal segments I to V; 4 on 6th and 2 on 7th segment; surrounded by chitinous rings; facets small, irregular in form; somewhat uniform in size.

Described from morphotype taken with holotype described below.

Apterous fundatrigenia.

Color: Head brown on front and vertex. Sides whitish with a brown patch around each ocular tubercle which is also brown. Antennal joints brown; I, darkest; II and VI darker than III, IV and V. Legs light brown, becoming darker at tip of femora and base of tibiae; tarsi darker than tip of tibiae. Body creamy white.

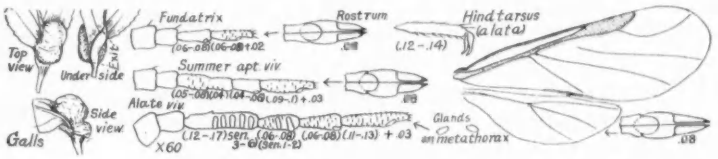

FIG. 3. *Pemphigus monophagus*, n. sp.

Measurements: Length, 1.44 mm.; Antennae; I, 0.05 mm. (0.04 to 0.05 mm.); II, 0.06 mm. (0.05 to 0.06 mm.); III, 0.08 mm. (0.07 to 0.08 mm.); IV, 0.04 mm.; V, 0.06 mm. (0.05 to 0.06 mm.); VI, 0.13 mm. (0.12 to 0.13 mm.). Fore femora, 0.26 mm. (0.23 to 0.26 mm.); tibiae, 0.22 mm. (0.20 to 0.22 mm.); tarsi, 0.11 mm. (0.10 to 0.11 mm.). Middle femora, 0.26 mm. (0.25 to 0.26 mm.); tibiae, 0.23 mm. (0.22 to 0.23 mm.); tarsi, 0.12 mm. (0.11 to 0.12 mm.). Hind femora, 0.34 mm. (0.33 to 0.34 mm.); tibiae, 0.32 mm. (0.29 to 0.33 mm.); tarsi, 0.13 mm.

Structural characters: Antennae, 6-jointed; separation between III and IV less distinct than between other joints. Spur about as long as greatest diameter of VI. Joints III, IV, V and VI imbricated; V and VI most strongly. Permanent sensoria at base of spur and near tip of V small; surrounded by cilia. Wax pores very weakly developed; apparently present on segments III to VII of the abdomen only. Rudimentary cornicles visible as dark rings. (Not visible on all individuals.)

Described from four morphotypes taken with holotype described below.

Sexupara.

Color: Head and thorax dark brown, appearing almost black. Body pale yellowish to yellowish green. Antennae dusky: I and II darker than other joints. Legs dusky; distal portion of femora and basal portion of tibiae darkest. Costal and subcostal veins of fore wing slightly dusky; other veins lighter. Band on posterior margin of stigma pale dusky.

Measurements: Length, 1.87 mm. (1.58 to 1.93 mm.). Antennae; I, 0.06 mm.; II, 0.07 mm.; III, 0.17 mm. (0.15 to 0.19 mm.); IV, 0.09 mm. (0.08 to 0.10 mm.); V, 0.10 mm. (0.08 to 0.11 mm.); VI, 0.18 mm. (0.15 to 0.18 mm.). Fore femora, 0.47 mm. (0.43 to 0.47 mm.); tibiae, 0.51 mm. (0.47 to 0.51 mm.); tarsi, 0.15 mm. (0.13 to 0.15 mm.). Middle femora, 0.39 mm. (0.38 to 0.39 mm.); tibiae, 0.53 mm. (0.52 to 0.54 mm.); tarsi, 0.15 mm. (0.13 to 0.15 mm.). Hind femora, 0.55 mm. (0.54 to 0.56 mm.); tibiae, 0.74 mm. (0.71 to 0.74 mm.); tarsi, 0.19 mm. (0.17 to 0.19 mm.).

Structural characters: Antennae, 6-jointed. Permanent sensoria at base of spur on VI and near distal end of V; surrounded by cilia. Secondary sensoria on III, IV, and V; narrowly to broadly oval; rarely exceeding diameter of joint in length; III, 5 (4 to 6); IV, 2 (1 to 2); V, R, 1; L, 0 (0 to 1); VI, 0. Joints V and VI imbricated; imbrications on III and IV at base only. Diameter of VI at distal end twice that of base; spur as long as greatest diameter of VI. Wax pores at inner posterior margins of lobes of metathorax smaller than the largest ones on prothorax; distance between them greater than their greatest diameter. Four pores on prothorax forming a trapezoid; the forward pair smaller and closer together than the others. (The larger pair, only, present in some individuals; in others these and but one of the forward pair present.) Wax pores on abdomen weakly developed. Fore wing with M simple; basal third obsolete; bases of diagonals quite close. One paratype has M and Cu united giving the latter the appearance of being forked. In another only 2 short sections of M are visible. Hind wing with bases united. Rudimentary gonopophyses 3.

Described from holotype and 16 paratypes from gall on *Populus balsamiferae* at 8,200 feet elevation, August 17, 1924, in Rocky Mountain National Park, Colorado.

Sexuales: The male is about 0.78 mm. in length; beakless; darker in color than the oviparous female. The antennae is 4-jointed; length of I, 0.026 mm.; II, 0.021 mm.; III, 0.017 mm. IV, including spur, 0.052 mm. I wider than long. Each succeeding joint narrower than the preceding. Permanent sensoria at base of spur and near distal end of III. Legs somewhat rudimentary. Tarsi shorter than diameter of tibiae; cone-shaped. The female 1.016 mm. long; beakless. Antennae 4-jointed; length of I, 0.026 mm.; II, 0.026 mm.; III, 0.034 mm.; IV, 0.069 mm.; segments more slender and more distinctly separated than in male; legs less rudimentary; tarsi well developed.

The Gall.

A more or less globular gall composed of leaf blade located at the base of the leaf with nearly circular opening on the under side closed by a thickened portion of the petiole that lays in a plane almost parallel to the blade of the leaf. The opening may be at the right or left of midrib. In a gall open on the right side of the midrib the thickened part of the petiole bends sharply to the left; then from a point near where the petiole passes into the midrib there is an abrupt bend to the right. Thus the thickened parts form a letter S. When the gall opens on the left of the midrib the S is backwards. There is usually a shallow furrow passing over the gall near its middle suggesting a double gall.

Taxonomy.—This species is placed in the genus *Pemphigus* because of the great structural similarity. In the number of generations and the sequence of forms it differs from the typical *Pemphigus*. There are but four generations, three of which, the fundatrix, fundatrigenia and sexupara, all develop in the same gall. Observations lead to the conclusion that all of the young of the fundatrix develop into apterous viviparae, these in turn producing the sexuparae. Further study may place this species in a new genus since it resembles *Pemphigus* much as *Cornaphis* does *Asiphum*.

What appears to be this species was taken by J. J. Davis on August 5, 1913, near Flat Head Lake in Montana. Material received from R. Glendenning collected at Lillooet and Merrit, B. C., on *Populus trichocarpa* also appears to be this species.

Types in U. S. Nat. Mus., Cat. No. 50065; paratypes in author's collection.

Asiphum rosettei n. sp.

(Fig. 4.)

Fundatrix.

Color: Mounted in balsam: Head, ocular tubercles, all segments of legs, and clypeus brown. Antennal segments light brown; I, II, distal end of IV and all of V darker than III and basal portion of IV. Tip of beak dark brown.

Measurements: Length, 2.76 mm. Antennae: I, 0.08 mm.; II, 0.08 mm.; III, 0.20 mm.; IV, 0.08 mm.; V, 0.18 mm. Fore femora, 0.43 mm.; tibiae, 0.37 mm.; tarsi, 0.14 mm. Middle femora, 0.40 mm.; tibiae, 0.34 mm.; tarsi, 0.14 mm. Hind femora, 0.54 mm.; tibiae, 0.48 mm.; tarsi, 0.15 mm.

Structural Characters: Antennae, 5-jointed; I, II and IV equal in length; III the longest. Spur short, indistinct. Tip of V appears to be brought to a one-sided point. Permanent sensoria at base of spur on V and near distal end of IV; small; surrounded by cilia. The one on

IV smallest and indistinctly visible. III, distinctly and IV weakly imbricated. All segments with scattering, curved hairs most of which stand nearly at right angles to the segments; segments of legs bearing similar hairs. Abdomen with small nearly upright hairs which gradually increase in size toward the caudal extremity where they are most numerous and much larger than elsewhere.

Described from morphotype taken with holotype described below.

Fundatrigenia.

Color: Mounted in balsam: Head, thorax, antennae, and legs light brown; head slightly darkest. Tip of beak dark brown. Wing veins and stigma pale yellowish brown.

Measurements: Length, 2.47 mm. (2.21 to 2.70 mm.). Antennae, I, 0.08 mm. (0.07 to 0.09 mm.); II, 0.09 mm. (0.09 to 0.095 mm.); III, 0.32 mm. (0.28 to 0.33 mm.); IV, 0.15 mm. (0.13 to 0.16 mm.); V, 0.18 mm. (0.16 to 0.19 mm.); VI, 0.23 mm. (0.21 to 0.24 mm.).

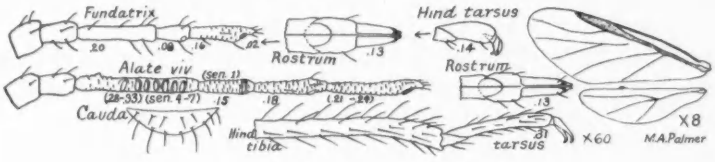

FIG. 4. *Asiphum rosetti*, n. sp.

Fore femora, 0.61 mm. (0.55 to 0.62 mm.); tibiae, 0.73 mm. (0.69 to 0.76 mm.); tarsi, 0.24 mm. (0.22 to 0.24 mm.). Middle femora, 0.54 mm. (0.52 to 0.56 mm.); tibiae, 0.81 mm (0.75 to 0.85 mm.); tarsi, 0.26 mm. (0.25 to 0.27 mm.). Hind femora, 0.73 mm. (0.69 to 0.80 mm.); tibiae, 1.0 mm. (0.91 to 1.06 mm.); tarsi, 0.31 mm. (0.27 to 0.31 mm.).

Structural Characters: Antennae, 6-jointed; secondary sensoria broadly oval, not exceeding diameter of joint in length; III; R, 5; L, 7 (4 to 7). IV, 1 (1 to 2). V, 0. VI, 0. Permanent sensoria at base of spur on VI and near distal end of V; large, more or less irregular in form; surrounded by cilia. All joints with a few hairs slightly curved near tip. Joints III to VI imbricated; III, weakly. III, irregular in diameter; thickest at base and tip; slightly curved near base with a blunt, rather indistinct spur on convex side of curved portion; IV and V gradually becoming thicker toward the distal end; V, most prominently so; VI, slightly curved, being more slender near middle than near base and distal end. Spur shorter than greatest diameter of distal portion of VI. Front broadly rounded; wider than length of joint III of antennae. Metathorax with two oval wax pores at inner posterior margin of lobes; distance between them greater than their longest diameter. Wax pores on abdominal segments 1 to 7. Fore wings with *M* once forked; fork long, originating nearer base of wing than a line

connecting the base of stigmal vein and tip of second diagonal. Length of stigma nearly equal to that of forward tibia; tip acute. Bases of diagonals well separated. Diagonals of hind wing arising from near the same point. (Sometimes united.) Legs, head, thorax and abdomen bearing slightly curved hairs; most numerous and largest at caudal extremity of abdomen. Rudimentary gonopophyses, 3.

Described from holotype and 9 paratypes taken on *Populus tremuloides*, 7,000 feet elevation in canyon of South St. Vrain Creek, Boulder Co., Colo., July, 1915.

The fundatrix appears to feed on the petioles of the newly opening leaves, causing them to become curved more or less backward. This forms a rosette of leaves by stunting the growth of the internodes of the young branch.

The fundatrigenia feed on the unexposed surfaces of the leaves forming the rosette. After the migration the young wood elongates somewhat so that the rosette gradually disappears except for a slight deformity of the branch and leaves.

Taxonomy: This species is very near *Asiphum tremulae* De Geer as described by Tullgren, but differs from it in having wax pores on lobes of metathorax and fewer secondary sensoria on III and IV of the antennae of the fundatrigenia.

U. S. Nat. Mus., Cat. No. 50066; paratypes in collections of author.

BOOK NOTICE

THE BUTTERFLIES OF THE MALAY PENINSULA, by A. S. CORBET AND H. M. PENDLEBURY. Pages i–v and 1–252. Frontispiece and one text plate in color. Two maps, 32 text figures and 14 photographic plates with 225 figures. 1934. Published by Kyle, Palmer & Co., Ltd., Kuala Lumpur, Federated Malay States. Price, $4.50.

Dr. Corbet is a member of the Rubber Research Institute of Malaya, while Mr. Pendlebury is Systematic Entomologist and Curator, Selangor Museum, Kuala Lumpur. The authors have produced a very usable handbook for collectors and other students of Malayan butterflies. It is written for use of amateurs with no entomological background whatever. Chapter I deals with insects in general and the anatomy of Lepidoptera; II, Nomenclature and Classification; III, Geographical Distribution; IV, Notes on Collecting; V, Preparation and Preservation of Specimens; VI, Colour, Pattern, Mimetic Resemblance, Habits, etc.; VII, Variation and Heredity; VIII–XI, Discussion of the Species, and XII, Catalogue of Malayan Butterflies and References to Literature. There are three indices.

There are no elaborate keys. The student identifies his material roughly by reference to the 225 photographs on the plates then by the index locates the name in the text, where is given under the scientific name a common name, notes on color, distribution and the distinctions of related varieties and species. This sounds "unscientific," but it appears to have been very carefully worked out and to be a very usable system.

The volume is bound in linen to stand field usage. The type used is large, with lines doubleleaded, the illustrations, except for a few of butterflies with dark and very obscure patterns, are clear and usable.—C. H. K.

COLEOPTERA OF ZION NATIONAL PARK[1]
No. II.

VASCO M. TANNER,
Brigham Young University, Provo, Utah

Since the appearance of my first paper on the beetles of Zion National Park (1928), considerable more collecting has resulted in the following additions to our knowledge of the beetle fauna of this part of Utah. A total of 333 species from 45 families have now been recorded. Three species are described in this paper as new to science.

FAMILY CICINDELIDAE

Cicindela oregona var. **maricopa** Leng not *C. oregona;* this is in conformity with my views on this group as presented in 1929.

FAMILY CARABIDAE

Tachys rapax (Lec). Rarely found in this region. Two specimens have been taken in 15 years of collecting.

FAMILY DYTISCIDAE

Ilybius subaeneus Er. Common in June and July.
Thermonectes marmoratus (Hope). Emerald pool.

FAMILY STAPHYLINIDAE

Megaquedius explanotus (Lec). This species is fairly common in July and August.

FAMILY SCAPHIDIIDAE

Scaphisoma castaneum Mots. Several specimens were taken in the bracket fungus on Fremont cottonwoods.

FAMILY PSELAPHIDAE

Richenbachia utahensis, n. sp. (Fig. 1).

Body convex, distended and rufescent, legs, elytra, prothorax, and head also rufescent, palpi flavo-testaceous, eyes large, coarsely granular and black; integument shining, head and prothorax punctulatus; elytra and abdomen subimpunctate; pubescence golden, rather abundant, short and decumbent, except along the posterior margins of the tergites, the distal article of the antennae, and the dilated portion of the tibiae where it is longer. Head slightly wider and longer than prothorax, the vertexal foveae deep and removed farther from the base than the apex; eyes black, large, prominent, facets distinct, which gives a granular

[1]Contribution No. 50, from the Entomological Laboratory, Brigham Young University, Provo, Utah.

appearance; each eye fills two-thirds of the space between the base and antennal sclerite. Antennae, prominent, considerably longer than the head and prothorax, and extremely modified in the male; first and second joints large and globose, third and fourth small, fifth, sixth and seventh joints greatly modified, especially the seventh, which has a flattened projection which makes the joint transversely longer than both the eighth and ninth joints combined; eighth joint small, about as wide as long; tenth joint larger than the ninth and the ninth larger than the eighth; the club as long as the combined eighth, ninth and tenth joints, smoothly formed and pointed, setiferous (Fig. 1). Prothorax one-third wider than long, sides evenly rounded, medium stria poorly developed with small fovea at base; lateral fovea large; pubescence sparse, short and decumbent; elytra one-fourth wider than long, suture one-fourth longer than the numeral width; sides divergent towards the tip; humeral and sutural striae well developed, ending basally in the first and third foveae; wings well developed, three and

FIG. 1

one-half times the length of the elytra. Abdomen not quite as wide, but as long as the elytra; carinae fine, slightly divergent. Legs rather long and slender, the hind femora swollen at their distal end, the hind tibiae slightly thickened toward the tip.

Length, 1.15 mm.; width, 0.55 mm.

Type Locality: Zion National Park, Washington Co., Utah. Collected by D. Eldon Beck, September, 1933, with the Berlese funnel.

Type a male, No. 39, and five paratypes, (1 ♂ and 4 ♀), in the author's collection at Brigham Young University.

This species, according to Col. Casey's key, belongs near *R. falli* Casey, but the antennae, prothorax, color and size do not agree. The male antenna is shown in Figure 1.

FAMILY MELYRIDAE

Collops granellus Fall. This species was taken in great numbers on thistle blossoms along the road on east rim of the canyon in the latter part of July, 1932.

Collops quadrimaculatus (Fab). Rarely taken in the park area. A few specimens have been taken along with *Collops granellus.*

Eudasytes grandicollis Blais. Fairly common in the cactus blossoms in May and June.

Attalus difficilis (Lec). Rare species. Only two specimens have been collected.

Tanaops mimus Fall. Rarely taken in this region. Two specimens from the park and one from St. George are now in my collection.

Vectura albicans Csy. This species is rather widely spread in western Utah and southern Idaho. Specimens from Zion Canyon, St. George, Grouse Creek, Deep Creek Mountains, Ibapah, Copper Mountains, and Raft River Mountains, Utah, and Shoshone Falls, Idaho, collected by D. Eldon Beck and the writer are represented in the university collection.

FAMILY CLERIDAE

Trichodes apivorus Germ. Seems to be rather rare. Two specimens taken on Yucca are in the collection.

Enoclerus lecontei Wolc. Abundant in August in the yellow pine on the east rim of the canyon.

FAMILY OEDEMERIDAE

Oxacis sp. Three species have been taken. One is fairly common on weeds near the public camp ground.

FAMILY MORDELLIDAE

Mordellistena rubilabris Hellm.

Mordellistena wickhami Lilj. Common on the Yucca.

Anaspis sericea Mann.

Anaspis rufa Say.

FAMILY RHIPIPHORIDAE

Rhipiphorus sp. Two species represented by seventy-five specimens were taken in a patch of Russian thistle on the east rim of the canyon, August 1932.

FAMILY MELOIDAE

Pyrota bilineata Horn. Rare.

Lytta biguttata Lec. Fairly common in August.

FAMILY ANTHICIDAE

Notoxus calcaratus Horn. Fairly common. Specimens have been taken in Zion Canyon, Grand Canyon and Bluff, Utah, and Tuba City, Ariz.

Notoxus desertus Csy. Five specimens taken by sweeping in June 1929.

FAMILY ELATERIDAE

Ludius cribrosus Lec. Common.

Cardiophorus pullus Bl.

Chalicolepidius apacheanus Csy.

Aeolus dorsalis (Say).

FAMILY BUPRESTIDAE

Agrilus gibbicollis Fall. Rare.

Agrilus walsinghami Crotch. Three specimens taken on Rabbit brush, *Chrysothamnus sp.*

Melanophila gentilis Lec.

Chrysobothris pubescens Fall. Four specimens were taken; two in June 1929, on the west rim trail.
Chrysobothris ludificata Horn.

FAMILY HETEROCERIDAE

Heterocerus collaris Kies. Common.

FAMILY DERMESTIDAE

Anthrenus parvus Csy. Several specimens taken on Yarrow.
Cryptorhopalum bakeri Csy. Rare species, two specimens taken in fungus.

FAMILY NITIDULIDAE

Meligethes aeneus (Fab). A rare species.

FAMILY PHALACRIDAE

Olibrus fallaciosus Csy. Five specimens taken from the bracket fungus on *P. fremontii.*

FAMILY COCCINELLIDAE

Neomysia interrupta Csy.
Scymnus weidti Csy. Seems to be a rather rare species; only two specimens have been taken.
Scymnus uteanus Csy. Fairly common. Specimens taken in Zion Canyon and Woodside, Grand County, Utah.
Scymnus decipiens Csy.
Psyllobora taedata Lec. One specimen was taken July 1932; size 1.9 mm.; agrees with LeConte's description.
Hyperaspis nunenmacheri Csy. One specimen, size 3.1 mm.; otherwise it agrees with Casey's description.

FAMILY ALLECULIDAE

Isomira variabilis Horn. Two specimens taken in June 1929.

FAMILY TENEBRIONIDAE

Eleodes cognata Hald.
Coniontis nevadensis Csy. Two specimens taken in June 1929.
Eleodes extricata Hald.
Eleodes manni subspecies *dilitícollis* Blais.
Blapstinus crassicornus Csy. Two specimens taken in September 1930.

FAMILY MELANDRYIDAE

Synstrophus repandus (Horn).
Eustrophinus arizonensis Horn. Both of these species seem to be taken rarely in this region.

FAMILY ANOBIIDAE

Ptilinus basalis Lec.
Catorama pingue Fall. One specimen was taken by sweeping in July 1932.

FAMILY CISIDAE

Octotemnus dixiensis, n. sp.

Form narrowly oval, size small, minutely pubescent; body blackish to rufotestaceous, legs, antennae, mouthparts flavo-testaceous, eyes large and coarsely granulate; antennae longer than prothorax, segments of club rather large and with long pubescence; maxillary palpi prominent, cones-haped; head not convex, sparsely punctured. Thorax about one fifth longer than wide, rounded at apex. Elytra one half longer than wide, very little wider than the thorax, densely but minutely punctate, each puncture bearing a seta, glabrous between the punctures; first ventral one and one half times as long as second ventral, second, third, fourth and fifth about equal; legs about equal throughout.

Length, 1.1 mm.; width, 0.1 mm.

Type locality: Zion National Park, Utah.

Type a male and three *paratypes* from Zion National Park; two paratypes from St. George, Utah, in the writer's collection. Specimens collected by the writer in bracket fungus on the Fremont cottonwoods.

The male genitalia well developed, female structures much as in *Cic ursulina* Csy. (Tanner, 1929, Pl. XI, Figs. 149–150.) Drawings of the genitalia are not presented here since adequate comparative material is not at hand.

FAMILY SCARABAEIDAE

Diplotaxis brevicollis Lec.
Diplotaxis subangulata var. *californica* Schffr.
Diplotaxis dentella Fall. Specimens found in Zion also in Bryce National Park.
Aphodius rubidus Lec. I am not sure that we have both of these species in Zion Park, but specimens have been so determined by several authorities on the Coleoptera.
Hoplia pubicollis Lec.
Hoplia sackeni Lec. Seems to be rare.
Serica alternata Lec.

FAMILY CERAMBYCIDAE

Tragidion coquus var. **fulvipenne** (Say). Two specimens taken in May 1929.
Malacopterus tellus (Fab).
Aethecerinus latecinctus Horn. One specimen collected in July 1932.
Oeme strangulata Horn.
Anoplium albofasciatum Linell.

FAMILY CHRYSOMELIDAE

Haltica sp.
Haltica bimarginata Say.

Lema nigrovittata Guer.
Zygogramma exclamations Fab.
Coscinoptera mucorea Lec.
Monoxia debilis Lec. Rare. One specimen taken in 1930.
Longitarsus sp.

FAMILY MYLABRIDAE

Mylabris gibbithorax Schffr. Breeds in the mesquite bean pods.
Mylabris uniformis Lec. Many specimens have been reared from the screw pods of *Strombocarpa odorata* (Torr. & Frem.).

FAMILY CURCULIONIDAE

Brachytarsus sp.
Peritaxia rugicollis Horn. Common.
Desmoris constrictus (Say).
Smicronyx sp.
Balaninus tubulatus Csy.
Anthonomus sp.
Epimechus mobilis Fall. Rare; only one specimen taken in September 1931.
Dinocleus wickhami Csy.
Trichobaris compicta Csy. Common in June 1929.
Aubeutes cruralis Lec.

Acanthoscelis utahensis. New species.

Robust oval, blackish, legs and entire body except the tip of the beak covered with yellowish, white scales, intermixed with brownish ones on the occipit and prothorax, scales round to oval and closely overlapping on the thorax, small and elongate on the elytra, large oval oblong on the underside especially on the meso- and metathorax; beak extending to the mesothorax between the coxal cavities, finely and sparsely punctured, fine long white scales partly obscuring the black glabrus anterior portion. Antennae originating in the middle portion of the beak, first joint of the funicle slightly longer than the second and greatly swollen at the distal end, second segment slender and about as long as the next two, third and fourth joints about equal, last three about as wide as long; the club large oval and covered with fine golden setae, white setae on the other segments of the funicle which are black; very little if any noticeable difference between the antennae of the males and females; prothorax slightly convex, two and one fourth times as wide at the base as the apex, the sides even between the base and apex; apical sulcus distinct, deepest on the dorsal portion, median line obscure, except near the basal pit; a few white scales at the apical and basal portion the remainder of the discal area covered with uniform brown scales. Elytra one fourth wider than the base of prothorax; humeral callus prominent, but removed from the base of the prothorax; convex wider at the base but becoming narrower toward apex, striae distinct but not prominent, clothed with whitish scales intermixed with a few brownish ones near the basal portion of the

suture; a marked depressed area around the scutellum, the basal line of the elytra between the prothorax black and noticeable; several black shining tubercles on the apical portion, three on the submarginal stria. Legs clothed with white scales, tibia slightly wider at the apex, all about the same size, tarsi medium size, fourth segment longer than the third and second. The first ventral segment as wide as the second and third; clothed with small close set white scales. Female, length 2.9 mm.; width, 1.9 mm. The male has an obscure fovea on the tip of the last segment.

Utahensis is nearest Dietz's *tarsalis*, but differs in being less constricted on the apex of the thorax, fourth joint of antenna shorter, about the length of the fifth, striae of elytra fine with small shining black tubercles on the submarginal stria and the declivity; also a smaller species.

Type a female, No. 36, and seven *paratypes* in the writer's collection at the Brigham Young University.

Type Locality: Zion National Park, Utah, collected by the writer July 28, 1932, on wild asters on the east rim of the canyon.

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BOOK NOTICE

THE NORTH AMERICAN AND WEST INDIAN DIGGER WASPS OF THE GENUS SPHEX (AMMOPHILA AUCT.), by H. T. FERNALD, pages 1–167, 2 plates. 1934. Published by H. T. Fernald, 707 E. Concord Ave., Orlando, Florida. Price, $2.50.

This is a revision of the thirty-eight North American forms of the Genus Sphex, twelve of which are described as new. Professor Fernald's study of this genus was begun more than twenty-five years ago. It has covered many thousands of specimens and the types of the majority of the species previously described. Pages 7–24 are devoted to a description and discussion of the anatomical characters used in classification, pages 25–37 to keys, and pages 38–160 to descriptions of species. There is an index of three pages. This is a very thorough piece of research and should be of great assistance to students of the genus Sphex. It is well printed and is bound in a heavy paper cover.—C. H. K.

BIOLOGY OF EUSCHISTUS VARIOLARIUS P. De B.

(Family Pentatomidae; Order Hemiptera)[1]

H. E. Parish,
Menard, Texas

Although contributions to the life history of American Pentatomidae have been made by Morrill (1910), *Pentatoma ligata* Say; Drake (1920), *Nezara viridula* Linn.; Chittenden (1908), *Murgantia histrionica* Hahn.; Knight (1923), *Perillus bioculatus* Fab.; nothing has been found on the biology of *Euschistus variolarius* P. De B.

Notes on the economic importance of *E. variolarius* have been presented by Howard (1899), Lugger (1900), Forbes (1905), Morrell (1910), and Watson (1914).

With few exceptions (Barber, 1914; Brimley, 1907), this species is seldom found south of latitude 37°.

Host plants. The reported host plants are corn, broom corn, rye, oats, wheat, red clover, red raspberries, peaches, tobacco, tomatoes, asparagus, mullein, golden rods, ragweed, burdock, and thistle.

The writer has taken adults on the following plants at Ames, Iowa: corn, oats, wheat, wild rye, blue grass, quack grass, chess, Canadian blue grass, foxtail, red clover, white clover, wild goose-berries, ground-cherries, beans, tomatoes, onions, squash, peas, thistle, ragweed, curled dock, wild sunflower, and mullein. Nymphs have been found on corn, oats, wheat, blue grass, wild rye, quack grass, Canadian blue grass, white clover, beans, tomatoes, ground-cherries, ragweed, foxtail, and mullein. Eggs have been collected from corn, wheat, tomatoes, beans, ground-cherries and mullein.

First-instar nymphs do not feed and rarely move about, but in the remaining nymphal stages feeding occurs regularly at intervals except a few hours before and after each molt. First-instar nymphs confined without food molted in the same length of time and were apparently as normal as individuals confined with food. Both adults and nymphs show marked preference for the tender shoots of succulent plants. They seek inconspicuous places to feed and rest and are seldom observed.

Protective coloration, "possuming," and secretions of the repugnatory glands play a great part in protecting this species from its enemies.

E. variolarius has been reported to prey upon lepidopterous larvae and cottony maple scale (Stoner, 1919), pupae of coccinellids (Folsom, 1909), and pea aphids (Davis, 1915). The writer found that, in con-

[1]Acknowledgments are due Doctors C. J. Drake, W. H. Welhouse, G. O. Hendrickson, Roy Melvin, and Mr. H. J. Reinhard.

finement, both adults and nymphs were cannibalistic, eating their own eggs, but was unable to force them to feed upon *Illinoia pisi* Kaltenbach, *Papaipema nebris* Guenee, *Leptinotarsa decemlineata* Say, and *Autographa brassicae* Riley.

Low temperatures and the disappearance of food plants drive adult *E. variolarius* into hibernation. Their favorite overwintering places are in beds of dry leaves, under mullein leaves, logs, and dead grass in fence rows. Preliminary studies on winter survival show 100 percent mortality when blanketed with snow; 84 percent mortality when covered with dry grass in fence row; 80 percent mortality in pine forest; 80 percent mortality in oak leaves with a north exposure; and 68 percent mortality in oak leaves with a south exposure.

Observations made during a falling temperature indicate that between 21° C. and 19° C. there was a marked decrease in activity; at 16° C. locomotion ceased; and below 11° C. no movement of appendages occured. However, it was possible to breed them continuously throughout the year under greenhouse conditions.

The egg. The eggs are light green in color, somewhat barrel-shaped, flat on top, the cephalic end being closed with a disc-shaped cap or lid. Around the outer edge of the lid, arranged in a regular circle, are found 28 to 30 club-shaped spines. At the time of deposition the eggs are light green in color, becoming cream colored as the embryo develops. The empty egg shells are transparent with a milkish white tinge. The chorion is delicately punctate, the chorial processes being large and abruptly thickened at the cephalic end. The egg is slightly longer than wide, being 0.53 mm. long and 0.44 mm. wide; the diameter of the disc-shaped lid is 0.33 mm. No variations were found in the measurements of eggs from the same cluster.

The eggs are normally deposited in regular compact rows but the number of rows and the number of eggs in each row vary. The number of eggs per cluster varies between 1 and 32, the average of 100 clusters being 17.67 eggs. Egg deposition takes place at the rate of 1.6 per minute. The eggs are deposited on the under side of leaves in the field, but when females are placed in captivity eggs are laid on both surfaces of leaves and also on soil, wood, and cheesecloth.

Under outdoor laboratory conditions the incubation period varies between 5 and 10 days. Hatching is similar to that of many other Pentatomids. Emergence of nymphs from an average size batch of eggs usually extends over a period of about 1¾ hours, taking from 11 to 15 minutes for each individual to emerge after the egg lid is first raised.

Table I is based on 20 individuals reared in separate containers under outdoor laboratory conditions. Nymphs were reared in 3-ounce, clear glass salve dishes covered with cheesecloth held in place by rubber bands. The food consisted of ripe tomatoes which were changed every 2 or 3 days. The containers were placed just out of reach of the direct rays of the sun and records were taken twice daily. Under outdoor conditions there is only one generation per year.

First-stage nymphs. Immediately after hatching the nymph becomes slightly longer than the egg, oval in outline, strongly convex, with the antennae and legs quite stout in proportion to the body. The general color is light cream with rather large, irregularly placed, pinkish spots on the abdomen and anterior tip of jugum. The eyes are rather large and light scarlet. The body and appendages are transparent. In a few minutes the general color grows darker and the color markings make their appearance. Just before molting this stage is about 1.90 mm. long and 1.40 mm. wide. The eyes are deep reddish brown and the basal joint of each antenna is brownish red. The thorax is entirely grayish brown. The

TABLE I.

Duration of the Pre-imagal Stages of *E. variolarius.*

Stage	Length in Days		
	Minimum	Maximum	Mean
Incubation	6	6	6
1st nymphal	6	6	6
2nd nymphal	9	14	11
3rd nymphal	8	12	10
4th nymphal	7	15	12.6
5th nymphal	8	17	10.6
Total			56.2

abdomen is somewhat lighter in color than the head and thorax and conspicuously marked with red. There are five semicircular grayish spots on each abdominal segment, two dorsolateral, two ventrolateral, and one ventromedian. The five somewhat rectangular areas on the dorsomedian line of the abdomen are reddish brown and vary greatly in size and shape, those on the second and third segments being the largest. The ventral surface of the body is yellowish gray, somewhat darker under the head. The legs and antennae are uniformly grayish; the beak is cream colored with the exception of the last segment, which is brown.

Second-stage nymphs. The second-stage nymph is 2.26 mm. long and 1.58 mm. wide. The head and thorax are white, with black dots. Near the base of the eyes, which are dark brown, is a large black spot. On each side of the median line of the thorax are two very irregular black areas. The abdomen is white and densely covered with distinct red marks. The semicircular abdominal spots and the rectangular dorsomedian areas are black with white

marking in the center. The head, beneath, is black with a white area on each side of the beak. The thorax is white, with irregular black markings. The abdomen, beneath, is yellow, prominently marked with red. The antennae are black, the basal segment and areas at the joints being white.

Third-stage nymph. The shape and color pattern of the third-stage nymph are very similar to the second. The abdomen is light green and less densely covered with red markings. The white areas in the semicircular marginal abdominal spots have from four to seven black scattered dots. The under side of the head has a wide white band across it which is scatteringly dotted with black. The legs are darker in color and clothed with rather short, stout spines. The mature form is 5.01 mm. long and 2.90 mm. wide.

Fourth-stage nymph. The fourth nymphal period is characterized by external development of the wing pads. The entire body is light green in color with the exception of a few black and red ventral markings. The red markings along the median line of the abdomen are very distinct and close together, whereas the other abdominal markings become paler and farther apart toward the margin. A distinct light colored median line runs the entire length of the thorax and is sparsely dotted with dark brown punctures. The head is rather densely dotted with brown. The antennae are reddish brown with the apical portion of the third segment and the entire fourth segment fuscous or black. The first segment of the beak is green, while the second and third are light brown and the fourth almost black. The coxa and apical two-thirds of the trochanter are light green, the femora dark yellowish brown, flecked with large brown spots. The tibiae and the under side of the femora have a few small, sharp pointed, black spines. The mature form is 8.16 mm. long and 4.97 mm. wide.

Fifth-stage nymphs. In the fifth-stage nymph the wing pads are very conspicuous, reaching the third abdominal segment. The head and thorax are dark yellow and rather densely punctate. The abdomen is entirely green with the exception of the vague remnants of the black semicircular spots on the margin of each segment. A densely red flecked area surrounds the remaining three dark brown rectangular median markings. The other ventral markings are almost identical with those of the previous instar. The mature form is variable in size, the average being 9.91 mm. long and 7.56 mm. wide.

From observations made under outdoor laboratory conditions on newly emerged adults which were reared in a steam-heated laboratory, the precopulation period ranges between 17 and 36 days, with an average of about 24.5 days. Mating begins a few days after coming out of hibernation. Normally the female mates only once, although a second copulation has been observed. The average time from copulation to egg laying is 27 days.

Three species of parasites, namely, *Trichopoda pennipes* Fab., *Gymnosoma fuliginosa* Desv., and *Cistogoster immaculata* Macq., all belonging to the family Tachinidae (Diptera), were bred from overwintering adults of *E. variolarius* at Ames, Iowa. Of the above species *T. pennipes* is the most important, parasitizing 3.8 percent of the adults collected in the spring of 1929.

SUMMARY

Notes have been presented on distribution, hibernation, influence of temperature on activity, duration of the incubation and nymphal stages, host plants, detailed descriptions of the various stages, together with a list of dipterous parasites reared from adult *E. variolarius*.

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BOOK NOTICE

ACTA PHAENOLOGICA. A Bi-Monthly Devoted to the Study of Phenology. 1931–1933. Vols. I–II, 1934. Vol. III. Published by Martinus Nijhoff, The Hague, Holland.

We wish to call attention to this recently established journal in the field of ecology. "Phenology is the science that teaches of the influence of external conditions (weather, situation, soil) upon moment and course of the periodical events of life. * * * It has a wide and valuable application agriculturally." The journal is now in its third volume.—C. H. K.

NEW OR LITTLE-KNOWN TIPULIDAE FROM CHIRIQUI, PANAMA

(Order Diptera)[1]

CHARLES P. ALEXANDER,
Amherst, Massachusetts

The crane-flies discussed herewith were collected in September, 1932, by Mr. W. K. A. Lawlor. They were taken not far from Boquete, chiefly at the Finca Parada (4,450 ft.), Finca Palo Alto (4,700 ft.) and Finca Lerida (5,300–7,000 ft.). Types and representatives of all species are preserved in my collection. In addition to the species discussed, a few other forms were included in the series, such material not being further identifiable at this time.

1. **Tanypremna opilio** O. S.

1 ♂, Finca Parada, September 12, 1932

2. **Limonia (Limonia) lawlori** sp. n.

General coloration of mesonotum and abdominal tergites dark brown; halteres obscure yellow, the knobs dark brown; femora brownish black, the bases paler; remainder of legs black; wings brownish yellow, variegated by clearer yellow and dark brown areas; vein Sc_2+R_1 strongly arched opposite fork of *Rs*.

Female.—Length, about 9 mm.; wing, 10.5 mm.

Rostrum and palpi black. Antennae black throughout; terminal segment very elongate and strongly constricted at midlength, about twice as long as the penultimate; longest verticils of flagellum exceeding the segments, unilaterally arranged. Head black.

Pronotum and mesonotum uniformly dark brown, the surface weakly polished, the scutellum and postnotum weakly pruinose. Pleura chiefly obscure yellow, the pleurotergite brown. Halteres obscure yellow, the knobs brown. Legs with the coxae and trochanters yellow; femora brownish black, the bases restrictedly obscure yellow; remainder of legs black. Wings with the ground-color brownish yellow, variegated by clear pale yellow or whitish yellow and dark brown areas; the yellow markings occur before and beyond the stigma, along *Rs* and in cells R_5, *1st* M_2, *2nd* M_2 and M_3; the dark brown areas include the stigma and a confluent area on anterior cord, with smaller areas at origin of *Rs*, tip of *Sc* and as marginal clouds at ends of longitudinal veins, larger at

[1]Contribution from the Entomological Laboratory, Massachusetts State College.

ends of veins R_3 and R_{4+5}; narrow dark seams along cord and outer end of cell *1st* M_2; outer portions of cells R_2 and R_3 strongly infuscated, the extreme margin fading to obscure yellow. Stigmal area with about 30 trichia on membrane. Venation: Sc_1 ending just before three-fourths the length of *Rs*, Sc_2 at its tip; *Rs* angulated at origin; vein Sc_2+R_1 strongly arched opposite level of fork of *Rs;* free tip of Sc_2 strongly arcuated; *m-cu* at fork of *M;* inner cell of *1st* M_2 arcuated.

Abdominal tergites uniformly brownish black; sternites obscure brownish yellow, the bases with a narrow darker ring. Ovipositor with cerci small, slender, strongly upcurved.

HABITAT: Panama (Chiriqui). *Holotype*, ♀, Finca Lerida, 5,300 ft., September 11, 1932 (Lawlor).

I take great pleasure in dedicating this fine species to the collector, Mr. W. K. A. Lawlor, who secured many notable Tipulidae in Chiriqui. The species is allied to *Limonia* (*Limonia*) *roraimæ* Alexander and *L.* (*L.*) *sanctæ-martæ* Alexander, of northern South America, differing very conspicuously in the details of coloration of body and legs. The wing-venation and pattern is rather similar in the three species and the affinities seem certain. The present fly differs from the other two species in the uniform dark brown mesonotum, uniformly darkened abdominal tergites and the darkened femora.

3. **Limonia** (**Limonia**) **ludibunda** Alex.

2 ♂♂, 1 ♀; Finca Lerida, 5,350–6,200 ft., September 14, 1932.

Condition poor. Smaller than the type from Chiapas, Mexico, but hypopygium identical. (*Male.*—Wing, 5.2–5.3 mm. *Female.*—Wing, 5.5 mm.).

4. **Limonia** (**Limonia**) **melaxantha** sp. n.

General coloration pale green; front and anterior vertex silvery; a narrow blackish median stripe on pronotum and most of praescutum; halteres green; middle and hind femora black except at extreme bases, with about the distal half yellow; posterior tibiae black with a broad, obscure yellow, subbasal ring; wings cream-yellow, the anterior border more saturated, the disk with restricted brownish black markings, including a common area at end of *Sc* and origin of *Rs;* origin of *Rs* very sharply bent.

Female.—Length, about 7 mm.; wing, 6.5 mm.

Rostrum moderately long, about one-half the remainder of head, black; palpi black. Antennae with scape black, pedicel brown; flagellum greenish; basal flagellar segments nearly globular, the outer passing to oval; terminal segment subequal to penultimate. Front and anterior

vertex silvery, the latter narrower than diameter of scape; remainder of head dark brown.

Pronotum black medially, greenish laterally. Mesonotum light green, the praescutum with a median black stripe that is gradually narrowed behind, at midlength of sclerite becoming capillary, obsolete before the suture. Pleura light green. Halteres pale green. Legs with coxae and trochanters green; femora with extreme bases yellow, more extensive on posterior pair; remainder of basal half of femora black, the entire outer half paling to yellow; fore and middle tibiae and tarsi black, posterior tibiae black, with an obscure yellow subbasal ring that includes about one-fourth the length of the segment; tarsi black. Wings pale cream-yellow, the prearcular region, costal border and narrow apical portion more saturated yellow; restricted but conspicuous brownish black marks, as follows: Arculus; a linear transverse area extends from *C* across tip of Sc_1, Sc_2 and origin of *Rs;* a smaller area in stigmal field, including free tip of Sc_2 and R_2; a small spot at tip of R_1; narrow brown seams along cord, outer end of cell *1st* M_2, tips of outer medial veins and a broad seam on distal fourth of vein *2nd A;* veins pale yellow, darker in the clouded areas; saturated yellow seams to anterior cord, vein *Cu* and the axilla. Venation: *Sc* very short, Sc_1 ending just beyond origin of *Rs*, Sc_2 not far from its tip; free tip of Sc_2 in approximate transverse alignment with R_2; *Rs* very sharply bent at origin, the extreme base lying slightly distad of the bend; *m-cu* subequal to distal section of Cu_1, close to fork of *M*.

Abdomen pale green. Ovipositor with cerci slender, upcurved.

HABITAT: Panama (Chiriqui). *Holotype*, ♀, Finca Lerida, 5,400 ft., September 13, 1932 (Lawlor).

Limonia (*Limonia*) *melaxantha* is most nearly allied to species such as *L.* (*L.*) *osterhouti* Alex. (Panama) and *L.* (*L.*) *repanda* Alex. (Ecuador), with *Sc* so short as to end approximately opposite the origin of *Rs;* the latter is bent strongly at origin, in the present form and in *repanda*, the base being actually directed somewhat proximad, the origin lying just distad of the point of angulation. The rather remarkable leg-pattern will serve readily to separate the present fly from other allied species. It seems probable that the conspicuous pale green body tints of the type will fade to a straw-yellow as the specimen ages.

5. **Limonia (Limonia) pampoecila** Alex.

Described from Costa Rica. 1 ♀, Finca Parada, 4,450 ft., September 11, 1932. I have also seen the fly from the Lower Paramo Zone, Silla de Caracas, Venezuela, 2,300 meters, December 21, 1930 (J. G. Myers).

6. **Limonia (Limonia) perflaveola** Alex.

Described from Mexico. 1 ♂, Finca Parada, 4,450 ft., September 11, 1932. This is probably only subspecifically distinct from *L.* (*L.*) *alfaroi* (Alex.).

7. **Limonia (Neolimnobia) diva** (Schin.)

Widespread in the Neotropics. 1 ♂, Finca Palo Alto, 4,700 ft., September 12, 1932; 1 ♀, Finca Lerida, 5,400 ft., September 13, 1932. "This had green meso- and metapleura, green halteres, green abdomen. green coxae, brown femora, tibiae and tarsi."—W. K. A. Lawlor.

8. **Limonia (Peripheroptera) atrosignata** sp. n.

Mesothorax reddish orange, the praescutum with a black triangle on anterior part of praescutum; anterior lateral angle of scutum with a black spot; femora yellow, the tips blackened; wings with costal border blackened, this color continued to wing-tip or slightly beyond, cell *C* being uniformly darkened; narrow dark seams on cord and outer end of cell *1st* M_2.

Male.—Length, about 6.5 mm.; wing, 8.6 mm.

Female.—Length, about 6 mm.; wing, 6 mm.

Rostrum and palpi black. Antennae black throughout. Head black, the anterior vertex with a reddish spot on either side adjoining the eyes; occipital region tinged with reddish, in female more uniformly darkened; anterior vertex (♂) relatively wide, subequal to width of anterior end of pronotum.

Pronotum black dorsally, yellowish on sides. Mesonotum reddish orange, variegated with black, including a triangular median line on anterior part of praescutum and rounded spots at outer cephalic portion of scutal lobes. Pleura uniformly reddish orange. Halteres obscure yellow, the knobs darkened. Legs with coxae reddish orange; trochanters yellow; femora yellow, the tips narrowly but conspicuously blackened, the amount subequal on all legs; tibiae light brown to brown, the tips passing into brownish black; tarsi black. Wings showing the usual sexual differences of the subgenus; in both sexes, the ground-color is yellowish, the costal border to wing-tip blackened, cell *C* uniformly darkened; a conspicuous dark area at arculus and others in region of stigma, along cord and outer end of cell *1st* M_2; wing-border, as far caudad and basad as tip of vein of Cu_1 narrowly and vaguely darkened; cell *Sc* is largely brighter yellow, variegated by dark areas at end and by a conspicuous seam at Sc_2; in male, cell R_1 is similarly bright yellow, in female more suffused with brown; veins brownish yellow, darker in the clouded areas. Venation: Male with prearcular cells of moderate size, being about two-thirds the length of cell *R;* inner ends of cells R_3, R_5, *1st* M_2 and M_4 nearly in transverse alignment; cell *2nd A* very narrow; female with prearcular region much shorter; *Rs* short, much less than basal section of R_{4+5}; cell *2nd A* a little wider than in male.

Abdomen chiefly reddish yellow, the segments narrowly bordered laterally by brownish black; hypopygium with ventral dististyles dusky; subterminal segments of female blackened. Male hypopygium with rostral prolongation short, with two spines of moderate size.

HABITAT: Panama (Chiriqui). *Holotype*, ♂, Finca Parada, 4,450 ft., September 12, 1932 (Lawlor). *Allotopotype*, ♀.

The nearest ally of the present fly is *Limonia* (*Peripheroptera*) *eudoræ* (Alex.) of Peru, which is readily told by the broad dark caudal margin of the wing. By my key to the species of *Peripheroptera* (Ent. News, 24: 409; 1913) the species runs to *L.* (*P.*) *schineri* (O. S.) of Brazil, an entirely distinct fly. The present insect is further told from all previously described forms by the uniformly blackened costal cell of the wings.

9. **Limonia** (**Rhipidia**) **flabelliformis** sp. n.

General coloration yellow; antennae (♂) bipectinate, with ten long-branched segments; pleura obscure yellow, with a conspicuous dark brown longitudinal stripe; tarsi black; wings creamy, with a dark costal pattern, the areas subequal in extent to the interspaces; abdominal segments bicolorous; male hypopygium with the ventromesal lobe of basistyle long and conspicuous.

Male.—Length, 7.5–8 mm.; wing, 7–7.2 mm.; antenna, about 4 mm.

Female.—Length, 6.5–7.5 mm.; wing, 7–8 mm.

Male.—Rostrum and palpi black. Antennae elongate, the scape and pedicel, together with the basal enlargements and branches of the flagellar segments, black; apical pedicels of all flagellar segments light yellow; terminal segment uniformly blackened; flagellar segments two to eleven, inclusive, long-bipectinate, the longest branches (at near midlength of organ) a trifle more than one-third as long as entire antenna; terminal segment a little shorter than the branch of the penultimate segment. Eyes contiguous on anterior vertex; posterior vertex gray, more infuscated medially.

Mesonotal praescutum brown, broadly bordered laterally and anteriorly by obscure yellow; scutum and scutellum brown, with a common pale median line; mediotergite brown on anterior portion, obscure yellow behind. Pleura obscure yellow, with a narrow, dark brown, dorsal stripe extending from the propleura to the abdomen, passing beneath the root of haltere. Halteres obscure yellow. Legs with coxae and trochanters yellow; remainder of legs chiefly broken or detached; one posterior leg still remains intact; femora obscure yellow, with a vague brown subterminal ring; tibiae and tarsi black. Wings with ground-color of anterior half creamy, of posterior half more grayish, the disk with a restricted brownish gray pattern that is chiefly costal in distribution, the areas subequal in size to the pale interspaces, the largest area being the second, at mid-distance between arculus and origin of *Rs;* areas at origin of *Rs* and tip of *Sc* separate; stigmal area

small, separated from a cloud over fork of *Rs;* narrow seams along cord and outer end of cell *1st* M_2; faint gray streaks near distal ends of outer radial cells; longitudinal pale streaks in cells *M*, *1st A* and *2nd A;* veins brown, yellow in the costal interspaces. Venation: *Sc* extending to near two-thirds the length of *Rs*, Sc_2 at tip; free tip of Sc_2 and R_2 in transverse alignment; *m-cu* shortly before the fork of *M*.

Abdomen long, the segments bicolorous, obscure yellow, ringed on apical third of fourth with blackish. Male hypopygium with the tergite narrow, both cephalic and caudal margins convexly rounded, the lateral angles nearly acute; caudal margin very minutely and insensibly notched medially. Basistyle with the ventromesal lobe very long and conspicuous, dusky, terminating in two fasciculate setae. Rostral spines two, subequal to or shorter than rostrum, placed close together at near midlength of prolongation; rostrum terminating in a powerful spinous seta.

Female.—As in male, differing in sexual characters. Antennae subpectinate, the apical pedicels short, pale yellow, contrasting with the larger dark-colored basal enlargements. Mesonotal praescutum with three more or less indicated brown stripes, the interspaces evident. Ventral sternopleurite weakly infumed. Wing-pattern more contrasted, especially the clouds in outer radial cells, which here form an incomplete fascia in this field. The allotype has the halteres much darker, almost black.

HABITAT: Panama (Chiriqui). *Holotype*, ♂, Finca Lerida, 5,400 ft., September 13, 1932 (Lawlor). *Allotopotype*, ♀. *Paratopotypes*, 1 ♂, 1 ♀, broken.

Limonia (*Rhipidia*) *flabelliformis* differs from *L.* (*R.*) *calverti* (Alex.) of Costa Rica in having the basal flagellar segment unbranched. The wing-pattern is somewhat as in *L.* (*R.*) *costaloides* (Alex.), an otherwise quite different fly. The branches of the male antennae of the present species are unusually long and graceful.

10. **Limonia (Rhipidia) variicosta** sp. n.

Allied to *costalis;* ground-color of mesonotal praescutum obscure orange-yellow, almost covered by dark brown stripes; rostrum, palpi and antennae black throughout; legs black, the femoral bases narrowly obscure yellow; wings blackish, the costal border variegated by narrow cream-colored interspaces.

Female.—Length, about 6 mm.; wing, 6 mm.

Rostrum and palpi black. Antennae black; flagellar segments more or less heart-shaped, with short, glabrous apical necks; terminal segment elongate, about twice the penultimate, narrowed outwardly. Head dark brown.

Mesonotal praescutum with the ground-color obscure orange-yellow, almost concealed by dark brown stripes that are confluent except for linear strips behind; lateral margins of sclerite darkened, restricting

the ground to sublateral brightenings; posterior sclerites of mesonotum brownish black. Pleura obscure, variegated by blackish, more noticeably so on the ventral anepisternum and meron. Halteres black, the base of stem obscure yellow. Legs with the femora black, the bases narrowly obscure yellow; tibiae and tarsi black. Wings very strongly suffused with black, the costal border cream-colored, variegated by five extensive, even darker costal areas, the last at stigma, the third at origin of *Rs;* on their posterior borders, these costal darkened areas merge into the dark ground-color of the disk, greatly restricting the pale costal spots; cord and outer end of cell *1st* M_2 narrowly bordered by blackish; veins brownish black. Macrotrichia of veins long and conspicuous. Venation: *Sc* long, Sc_1 ending about opposite two-thirds *Rs*, Sc_2 close to its tip; *m-cu* at fork of *M*.

Abdominal tergites brownish black, the sternites more bicolored, obscure yellow, the caudal margins narrowly dark brown, the outer sternites more uniformly darkened. Ovipositor with cerci slender and rather strongly upcurved.

HABITAT: Panama (Chiriqui). *Holotype*, ♀, Finca Parada, 4,450 ft., September 12, 1932 (Lawlor).

The nearest ally of the present fly would appear to be *Limonia* (*Rhipidia*) *costalis* (Will.), which differs conspicuously in the coloration of the body, legs and wings, more especially the opaque reddish mesonotum, the reddish abdomen, with the caudal borders of the tergites darkened, the yellow tips of the femora, the much paler wings and the details of venation, as the short *Sc*, which ends at or before midlength of *Rs*.

11. **Limonia** (**Geranomyia**) **cerberus** (Alex.)

1 ♂, 1 ♀, Finca Parada, 4,450 ft., September 11, 1932

12. **Limonia** (**Geranomyia**) **deliciosa** sp. n.

General coloration yellow, the praescutum with an intermediate pair of reddish brown stripes, the lateral praescutal borders broadly darker brown; rostrum and antennae black; femora obscure yellow, the tips clearer yellow, preceded by a dark brown ring; wings cream-yellow, with a chiefly marginal brown pattern, the third costal spot being a common one embracing the origin of *Rs* and end of *Sc;* vein *Sc* relatively short, Sc_1 ending just beyond origin of *Rs;* male hypopygium with the two rostral spines slender, gently curved, arising from the summit of a single rounded domelike tubercle.

Male.—Length, excluding rostrum, about 5.5 mm.; wing, 6.8 mm.; rostrum, about 3 mm.

Female.—Length, excluding rostrum, about 7–7.5 mm.; wing, 7 mm.; rostrum, about 3 mm.

Rostrum, palpi and antennae black, the latter in male approximately one-half as long as body. Head blackish, with a linear pale median stripe that is equal in width to the anterior vertex.

Mesonotal praescutum ochreous, with an intermediate pair of reddish brown stripes that are separated by a capillary line of the ground; lateral borders of praescutum broadly darker brown; scutum testaceous medially, the lobes extensively dark brown; scutellum chiefly brownish testaceous; mediotergite chiefly dark brown. Pleura with ventral portion yellow, the dorsal portions somewhat darker, with a conspicuous blackened area on anepisternum. Halteres greenish yellow, the knobs infuscated. Legs with the coxae and trochanters yellow; femora obscure yellow, the tips clearer yellow, preceded by a narrow dark brown ring; tibiae and tarsi chiefly pale brownish yellow, the outer tarsal segments infuscated. Wings with the ground-color strongly cream-yellow, the prearcular and costal areas more saturated yellow; a series of about eight marginal brown areas, of which five are on the costal border, the third at end of *Sc* and origin of *Rs*, the fourth at stigma, the last at end of vein R_3; the remaining clouds lie at ends of veins *Cu*, *1st A* and *2nd A;* cord and outer end of cell *1st* M_2 narrowly seamed with brown; tips of veins R_{4+5} to M_4, inclusive, restrictedly darkened; veins yellow, darker in the clouded areas. Venation: *Sc* short, Sc_1 extending to a short distance beyond origin of *Rs*, Sc_2 not far from its tip; a supernumerary crossvein in cell *Sc; m-cu* close to fork of *M*.

Abdominal tergites light to darker brown, the sternites clear yellow. Male hypopygium with the ventral dististyle relatively large and fleshy, the rostral prolongation unusually slender; rostral spines arising from a common dome-shaped tubercle that is placed at base of rostrum; spines subequal, slender, gently curved. Gonapophyses with mesal-apical lobe relatively slender, parallel-sided, at apex directed laterad into a small point or tubercle.

HABITAT: Panama (Chiriqui). *Holotype*, ♂, Finca Parada, 4,450 ft., September 12, 1932 (Lawlor). *Allotopotype*, ♀. *Paratopotypes*, 3 ♀ ♀.

The coloration and venation of wings of the present fly is much as in *Limonia* (*Geranomyia*) *eurygramma* (Alex.), but the thoracic pattern and structure of the male hypopygium is very different.

13. **Limonia** (**Geranomyia**) **eurygramma** Alex.

Known hitherto only from Mexico. 1 ♂, 1 ♀, Finca Parada, 4,450 ft., September 12, 1932.

14. **Limonia** (**Geranomyia**) **lachrymalis** (Alex.)

Known hitherto only from Ecuador and Peru. 1 ♂, Finca Parada, 4,450 ft., September 12, 1932.

15. **Helius** (**Helius**) **albitarsis** (O. S.)

Widespread in the Neotropics. ♂, ♀, Finca Parada, 4,450 ft., September 11, 1932.

16. **Helius (Helius) panamensis** sp. n.

Belongs to the *mirabilis* group; general coloration pale yellow; head light gray; femora yellow, the tips very narrowly and conspicuously blackened; mediotergite darkened; wings yellow-subhyaline, with a restricted pale brown pattern distributed as a broken fascia along cord and as a longitudinal cloud at near midlength of first section of Cu_1; *r-m* distinct.

Male.—Length, about 4.5 mm.; wing, 5.2 mm.

Female.—Length, about 5 mm.; wing, 5.3 mm.

Rostrum yellow. Antennae pale brown, the basal two segments a little brighter. Head light gray.

Mesothorax pale yellow, any reddish cast normally present poorly indicated; mediotergite darkened. Halteres pale throughout. Legs with coxae and trochanters yellow; femora yellow, the tips very narrowly but abruptly and conspicuously blackened; tibiae and tarsi yellow, the outer tarsal segments a little darker. Wings very pale yellow to yellowish subhyaline, with a restricted pale brown pattern, the stigma and a longitudinal cloud at near midlength of the first section of vein Cu_1 slightly darker brown than a more grayish brown seam along the anterior cord, fork of *M* and end of vein Cu_1, the three last more or less interrupted and not forming a continuous band along cord; veins pale yellow, a little darker in the clouded areas. Venation: *r-m* distinct, subequal to basal section of R_{4+5}; inner end of cell *1st* M_2 strongly arcuated, the cell thus lying far basad of the elements of the outer radial field; *m-cu* a distance beyond fork of *M* about equal to *r-m* or less.

Abdomen of male almost uniformly yellow, of female bicolorous, the bases of the individual segments broadly and conspicuously ringed with brown, the remainder yellow.

HABITAT: Panama (Chiriqui). *Holotype*, ♂, Finca Parada, 4,450 ft., September 12, 1932 (Lawlor). *Allotopotype*, ♀.

The nearest ally is *Helius* (*Helius*) *rubicundus* (Alex.) of Paraguay, which has the tips of the femora more gradually and broadly infuscated rather than narrowly and abruptly blackened; the general coloration of body more reddish yellow; the dark abdominal markings in female more nearly continuous to form a broken longitudinal stripe, and other characters. This is the first record of a species of the group from North America, the other forms being widespread in tropical South America.

17. **Epiphragma (Epiphragma) circinata** O. S.

Described from a single female, Mt. Irazu, Costa Rica, 6,000–7,000 ft. (Rogers). A few specimens in the present series, including both sexes; Finca Parada, 4,450 ft., September

11, 1932; Finca Palo Alto., 4,700 ft., September 12, 1932; Finca Lerida, 5,300–7,000 ft., September 14, 1932.

The femora, broken in the unique type, offer distinctive features of pattern; basal third yellow, passing into brown, the latter ending abruptly at near two-thirds the length of the segment, the apical third with a black subterminal ring, the apex and an antepenultimate ring of slightly greater extent, bright yellow; tibiae brownish black, the extreme base and apex yellow; tarsi paling to brownish yellow. Abdominal sternites conspicuously yellow. The above characters are likewise found in the Mexican *E.* (*E.*) *oreonympha* Alex., which has the abdomen conspicuously hairy and the stigmal area of wing more uniformly darkened. The stigmal region in *circinata* is likewise distinctive, there being three or four small, isolated, dark spots in the region normally occupied by the single stigmal area.

18. **Epiphragma** (**Epiphragma**) **genualis** sp. n.

General coloration black; antennae (♂) elongate, black, the first flagellar segment pale; halteres elongate; femora and tibiae black, the genua conspicuously whitened; wings whitish, with a conspicuous reticulate and ocellate brown pattern; stigmal region uniformly darkened; abdomen brownish black, the caudal borders of the tergites narrowly pale, sternites black.

Male.—Length, about 9 mm.; wing, 10.5 mm.

Rostrum and palpi black. Antennae (♂) elongate, as in *circinata*, if bent backward extending about to one-third the length of abdomen; scape and pedicel black; flagellum black, the first segment more or less yellow, in one specimen entirely pale, in the type with only the base brightened; segments long-cylindrical, with a dense and very delicate pubescence and a few scattered verticils that are shorter than the segments. Head dark brown; anterior vertex very narrow, only about two-thirds the diameter of the scape.

Disk of mesonotal praescutum dull brown, sparsely pollinose, with two intermediate brown stripes; cephalic and lateral borders of the sclerite broadly and conspicuously blackened; anterior lateral pretergites restrictedly pale; posterior sclerites of notum infuscated. Pleura almost uniformly blackened, with a sparse gray pruinosity. Halteres elongate, blackened, the basal half of stem yellow. Legs with coxae black, sparsely pruinose; trochanters obscure yellow; femora obscure yellow basally, thence passing into black, the tips narrowly whitened; tibiae black, the bases narrowly white, subequal in amount to the femoral tips; tarsi paling to brownish yellow. Wings whitish, with a conspicuous brown pattern that is much as in *circinata*, being distributed in a reticulate and ocellate pattern; region of stigma uniformly darkened, not with a series of about four brown dots, as in *circinata;* outer end of cell *2nd A* variegated by a pale area; veins brown. Venation: *Rs* angulated and spurred at origin; R_{2+3+4} relatively short, less than one-half *Rs*, subequal to the petiole of cell M_1.

Abdomen brownish black, the caudal borders of tergites narrowly pale, the areas continued for a slight distance cephalad along the lateral

borders; transverse subbasal impressions black, little evidence against the ground; sternites black throughout.

HABITAT: Panama (Chiriqui). *Holotype*, ♂, Finca Lerida, 5,300–6,200 ft., September 14, 1932 (Lawlor). *Paratopotype*, a fragmentary ♂, 5,400 ft., September 13, 1932.

Epiphragma (*Epiphragma*) *genualis* is readily told from the other regional allied species with elongate antennae in the male (as *circinata* O. S., *gracilicornis* Alex., *oreonympha* Alex.) by the pattern of the legs.

19. **Limnophila dictyoptera** Alex.

A pair, in copula, Finca Lerida, 5,300 ft., September 15, 1932.

20. **Shannonomyia atroapicalis** sp. n.

General coloration buffy yellow; front and anterior vertex silvery; legs yellow, the tips of all femora narrowly but intensely blackened; wings strongly tinged with brownish yellow, the outer radial field a little darkened; a restricted dark brown pattern, including the stigma, origin of *Rs*, cord and outer end of cell *1st* M_2; R_2 close to fork of R_{2+3+4}; cell *1st* M_2 closed.

Male.—Length, about 5.5 mm.; wing, 6 mm.

Rostrum yellow; palpi brownish black. Antennae with two basal segments yellow, the flagellum brownish black; flagellar segments oval. Front and anterior vertex broad, silvery; posterior vertex more infuscated.

Mesonotum light buffy yellow, the praescutum with vaguely darker stripes that are best-indicated behind; posterior border of scutellum conspicuously fringed with long yellow setae. Pleura testaceous yellow. Halteres chiefly pale. Legs with coxae, trochanters and femora yellow; tibiae light yellow, the narrow tips abruptly and intensely blackened, the amount subequal on all legs; tarsi obscure yellow, the very narrow tips of the basal three segments infuscated, the outer segments uniformly darkened. Wings strongly tinged with bright yellow, the costal border clearer yellow; outer radial cells slightly suffused with brownish; a restricted but very conspicuous dark brown pattern, as follows: Origin *Rs*, stigma, cord and outer end of cell *1st* M_2; veins yellow, darker in the infuscated areas. Venation: Sc_1 ending just before fork of *Rs*, Sc_2 at its tip; *Rs* of moderate length, angulated and spurred at origin; R_2 immediately beyond point of departure of R_1, R_{2+3} thus reduced to a mere point; cell *1st* M_2 elongate, exceeding vein M_{1+2} beyond it; *m-cu* at just before two-fifths the length of cell *1st* M_2.

Abdominal tergites yellow, each with a conspicuous, transverse, impressed line beyond base, this suffused with brown to produce a vaguely bicolorous appearance; sternite and hypopygium more uniformly yellow. Male hypopygium with the gonapophyses appearing as very slender, strongly curved hooks.

HABITAT: Panama (Chiriqui). *Holotype*, ♂, Finca Parada, 4,450 ft., September 12, 1932 (Lawlor).

The nearest ally of this fly is *Shannonomyia argenticeps* Alex. (Ecuador), which differs very evidently in the uniformly yellow legs and much less distinct wing-pattern.

21. **Atarba** (**Atarba**) **apicispinosa** sp. n.

Mesonotum yellow; antennae bicolorous, the flagellar segments black with the bases narrowly yellow; legs yellow; wings pale gray, the costal region clear light yellow; stigma very faint; *Sc* short, cell *1st* M_2 narrowed outwardly; male hypopygium with the outer dististyle slender, blackened, with three or four slender spines on outer margin, the outermost some distance before the long curved apical spine; inner dististyle a little dilated at outer end.

Male.—Length, about 5 mm.; wing, 5 mm.

Rostrum yellow; palpi brownish black. Antennae with scape and pedicel yellow; flagellum bicolorous, each segment black with the extreme base yellow, the amount not involving more than the basal sixth or seventh, decreasing in amount on outer segments, the terminal five or six uniformly darkened; segments cylindrical, with verticils that are much shorter than the segments. Head yellow, very sparsely pruinose.

Mesonotal praescutum yellow, the posterior sclerites of notum somewhat more testaceous-yellow. Pleura yellow, more testaceous behind, the dorsopleural region dusky. Halteres pale, the knobs dusky. Legs yellow. Wings with a pale gray tinge, the costal region pale yellow; stigma very pale brown; veins pale. Venation: Sc_1 ending just beyond origin of *Rs;* outer end of cell *1st* M_2 conspicuously narrowed, *m* being much shorter than the basal section of M_3, in the type so short as to be virtually eliminated.

Abdominal tergites dark brown, the segments more or less brightened basally; subterminal segments uniformly darkened; sternites more yellow; hypopygium pale. Male hypopygium with the outer dististyle slender, blackened, with three or four slender, subappressed spines along outer margin, the apical spine elongate, curved; outermost spine removed to some distance back from apex. Inner dististyle subequal in length to outer, the distal end a little enlarged. Plate of ninth sternite a little longer than broad, the outer lateral angles produced laterad into acute spines.

HABITAT: Panama (Chiriqui). *Holotype*, ♂, Finca Lerida, 5,400 ft., September 13, 1932 (Lawlor). *Paratopotype*, 6,200–7,000 ft., September 14, 1932 (Lawlor).

The present fly is well-distinguished from regional allies by the structure of the male hypopygium, especially the length of the apical spine of the outer dististyle and the position of the outermost lateral spine removed from apex. The nature of

antennal pattern likewise furnishes important specific characters. The species is most generally similar to *Atarba* (*Atarba*) *boliviana* Alex. (Bolivia) and *A.* (*A.*) *varicornis* Alex. (Peru), but is distinct from both.

22. **Hexatoma** (**Eriocera**) **interlineata** sp. n.

Allied to *zonata;* general coloration of mesonotal praescutum golden-yellow, with three black stripes, the median one split by a capillary pale line; femora yellow, the tips narrowly blackened; wings with apical and posterior cells extensively suffused with pale brown; abdomen yellow, the subterminal tergites blackened.

Female.—Length, 25–27 mm.; wing, 18–20 mm.

Rostrum and palpi dark brown. Antennae with scape and pedicel reddish brown; basal two flagellar segments yellow, the succeeding segments black. Head obscure orange, deeper orange on sides of posterior vertex.

Mesonotal praescutum golden-yellow, with three conspicuous black stripes, the median one narrowly but conspicuously divided by an obscure yellow vitta; humeral region restrictedly blackened; posterior sclerites of mesonotum obscure yellow, the centers of the scutal lobes extensively blackened; mediotergite with a conspicuous depressed quadrate blackened area at each cephalic lateral angle; a smaller linear black mark at posterior lateral region of mediotergite. Pleura blackened dorsally beneath the wing-root and on meral region, the sternopleurite golden-yellow pollinose. Halteres yellow, the knobs black. Legs with coxae somewhat infuscated, especially the posterior pair; trochanters yellow; femora yellow, the tips narrowly and abruptly blackened, the amount subequal on all legs; tibiae yellow, the tips even more narrowly blackened; tarsi obscure yellow basally, the outer segments passing into black. Wings yellow, the prearcular and costal regions somewhat more saturated yellow; stigma pale brown; even paler brown clouds along R_5, in cells beyond cord and in Cubital and Anal fields, these appearing chiefly as broad seams to the veins, leaving the centers of the cells somewhat paler; veins brown, yellow in the flavous areas. Venation: Sc_1 lying some distance before the tip of Sc_2, the latter stout and angulated; R_{2+3} a little longer than R_2 alone; basal section of R_5 shorter than *r-m; m-cu* just beyond fork of M, slightly exceeding the distal section of Cu_1.

Abdomen yellow, the fifth and sixth tergites chiefly black; sternites more uniformly pale. Ovipositor with long straight cerci; hypovalvae terminating in a hairlike point.

HABITAT: Panama (Chiriqui). *Holotype*, ♀, Finca Parada, 4,450 ft., September 12, 1932 (Lawlor). *Paratopotype*, ♀.

The nearest allies of the present fly are *Hexatoma* (*Eriocera*) *ohausiana* (End.)., of Ecuador and Peru, and *H.* (*E.*) *zonata* (O. S.) of Mexico and Guatemala, both of which have the same peculiar venation of the subcostal field, the sunken areas on the

mediotergite, and the tips of the femora narrowly blackened. The present fly differs from the others in the virtually complete division of the median praescutal stripe by a pale line, the different wing-pattern, and the slightly different ovipositor.

23. **Hexatoma (Eriocera) stolida** sp. n.

Allied to *macrocera* Alex.; mesonotal praescutum obscure yellow, with three vaguely indicated darker stripes; knobs of halteres dark brown; femora obscure yellow, the tips narrowly infuscated; wings with a brownish yellow suffusion, the costal region brighter yellow; stigma brown, short-oval; abdomen yellow, the incisures of segments narrowly but conspicuously brownish black.

Female.—Length, about 11 mm.; wing, 10 mm.

Rostrum reduced, obscure yellow; palpi short, brownish black. Antennae with scape obscure yellow, the succeeding segments brownish black to black. Head obscure yellow.

Mesonotal praescutum obscure yellow, with three vaguely indicated slightly darker brown stripes; posterior sclerites of notum concealed by mounting medium. Pleura grayish brown, the sternopleurite a little brighter. Halteres obscure yellow, the knobs infuscated. Legs with coxae and trochanters testaceous-yellow; femora obscure yellow, the tips narrowly infuscated; tibiae brown; tarsi black. Wings with a brownish yellow suffusion, the costal region somewhat brighter yellow; stigma brown, short-oval; narrow to scarcely evident brown seams along veins, including the cord; veins brown, more yellow in the flavous areas. Venation: R_{1+2} and R_2 subequal; R_{2+3} about one-half longer than R_2 alone; cord moderately oblique; *m-cu* immediately beyond fork of M, in virtual alignment with the anterior cord; cell M_1 lacking; distal section of Cu_1 a trifle shorter than *m-cu*.

Abdomen yellow, the incisures of the segments narrowly but conspicuously brownish black, the color involving the narrow apices of the segments, together with the slightly wider bases of the succeeding segments. Ovipositor with elongate valves.

HABITAT: Panama (Chiriqui). *Holotype*, ♀, Finca Parada, 4,450 ft., September 11, 1932 (Lawlor).

The present species finds several allies in the Neotropics, but seems readily separable therefrom in the diagnostic features indicated, notably the coloration of the body, pattern of wings and conspicuously fasciate abdomen. No approximately similar species was known to Osten Sacken or Williston at the time of preparation of the Diptera volumes for the Biologia Centrali-Americana (1886–1901).

24. **Trentepohlia (Paramongoma) chiriquiana** sp. n.

General coloration light reddish brown, the praescutum with three slightly darker brown stripes; basal antennal segments brown, flagellum

black, leg black, the narrow tips of femora and slightly wider bases of tibiae dirty white, the femoral bases broadly pale; wings yellow, only the small longitudinal stigmal area darker; veins yellow.

Female.—Length, about 11.5 mm.; wing, 9.5 mm.

Rostrum yellow; palpi brownish black. Antennae with scape and pedicel brown; flagellum black; flagellar segments long-cylindrical, with short inconspicuous verticils. Head light reddish brown, carinate on the narrow anterior vertex.

Mesonotal praescutum light reddish brown, with three very slightly darker brown stripes, the median one faintly divided by a pale vitta; posterior sclerites of notum brown, the scutal lobes darkened, the median area more yellowish. Pleura chiefly yellow, the dorsal sclerites darker. Halteres pale yellow, the knobs infuscated. Legs with coxae brownish yellow; trochanters yellow; femora obscure yellow basally, at or near midlength passing into black, the tips very narrowly and abruptly yellowish white; tibiae black, the bases narrowly dirty yellowish white, the amount about twice as extensive as the femoral tips; tarsi black. Wings strongly tinged with yellow, the costal region more saturated; stigma small, dark brown, longitudinal in position, involving only the cephalic half of vein R_2; veins yellow. Venation: R_{2+3+4} elongate, about two-thirds the long, gently arcuated Rs; R_{3+4} short, less than R_{1+2}; in the left wing of type, cell *1st* M_2 is open by atrophy of outer Medial veins, the condition undoubtedly abnormal.

Abdominal tergites brown, the sternites more yellowish.

HABITAT: Panama (Chiriqui). *Holotype*, ♀, Finca Parada, 4,450 ft., September 12, 1932 (Lawlor).

Trentepohlia (*Paramongoma*) *chiriquiana* is very different from all other described species of *Paramongoma* in the combination of blackened tarsi and tibial tips and the uniformly yellow wings, with only the narrow stigma dark brown. The pale, scarcely marked wings are much as in *T.* (*P.*) *leucoxena* (Alex.) of Mexico, and *T.* (*P.*) *sororcula* (Alex.) of Panama, which have the tarsi snowywhite. Of all the known Neotropical species of the genus, the present fly has a leg-pattern similar only to that of *T.* (*P.*) *geniculata* (Alex.), of British Guiana and Brazil, the latter species differing conspicuously in the venation and heavily patterned wings.

25. **Teucholabis** (**Teucholabis**) **leridensis** sp. n.

Mesothorax polished black, variegated only on praescutum, and more extensively on meral region, by pale color; antennae moniliform; head reddish brown; prothorax yellow; knobs of halteres yellow; fore legs black, the remaining femora yellow; wings whitish subhyaline, with a restricted darker pattern, including a pale brown apex and a major oval cloud at near midlength of first section of vein Cu_1; abdominal tergites and hypopygium black, the sternites ringed with yellow.

Male.—Length, about 4.8–5 mm.; wing, 5.6–5.8 mm.

Rostrum reddish brown; palpi a little darker. Antennae with basal segments obscure brownish yellow, the outer segments black; flagellar segments subglobular, with short pedicels that are placed slightly on one side of the segments, not in the exact central portion, this giving the organ a weakly serrate appearance. Head reddish brown.

Pronotum yellow. Mesonotum polished black, variegated only by restricted yellowish areas at cephalic portion of praescutum, on either side of midline, and at midregion of the suture. Pleura chiefly blackened, the propleura and meral region yellowish, the latter area extensive, connected along suture between sternopleurite and pteropleurite with a larger area at wing-root and on dorsopleural region. Halteres black, the knobs yellow. Legs with coxae and trochanters yellow; fore legs black, only the femoral bases narrowly obscure yellow; middle and hind legs with femora obscure yellow, the tips vaguely darker; tibiae and tarsi more brownish black to black; posterior tibiae, before tips, with a small cushion of delicate erect setulae, the segments a trifle dilated at this point; proximal end of posterior basitarsus slightly dilated and modified. Wings whitish subhyaline, with a restricted darker pattern; stigma and proximal two-thirds of cell *Sc* brownish black; wing-tip, back to level of outer end of cell *1st* M_2, a large oval cloud at near mid-length of first section of vein Cu_1 and a weak cloud at end of vein *1st A*, paler brown. Venation: *Sc* short, Sc_1 ending opposite or before one-fourth the length of *Rs*, Sc_2 usually before the origin of the latter, never far beyond this point; R_2 at or just beyond the end of *Rs; m-cu* close to fork of *M*.

Abdominal tergites, including hypopygium, black; sternites two to four, inclusive, narrowly ringed with yellow on posterior portions, the subterminal segments more uniformly yellow; sternal pocket blackened. Male hypopygium much as in *nigrosignata;* inner dististyle with apical beak not bidentate.

HABITAT: Panama (Chiriqui). *Holotype*, ♂, Finca Lerida, 5,350–6,200 ft., September 14, 1932 (Lawlor). *Paratopotypes*, 8 ♂♂.

The wing-venation is much as in *Teucholabis* (*Teucholabis*) *hilaris* Alex. (Peru) and *T.* (*T.*) *nigrosignata* Alex. (Cuba), but the wing-pattern, notably the large oval spot on vein *Cu*, together with the body-coloration, readily separate the fly from all described allies.

26. **Gonomyia** (**Lipophleps**) **gillottæ** Alex.

Known hitherto only from the type, taken in Costa Rica. One fragmentary ♂, Finca Parada, 4,450 ft., September 12, 1932.

27. **Gonomyia (Lipophleps) peracuta** Alex., var.

One ♂, 3 ♀ ♀, Finca Parada, 4,450 ft., September 12, 1932. Somewhat larger than the type from Chiapas, Mexico, and with slight differences in the male hypopygium, which may later provide subspecific characters.

28. **Cryptolabis (Cryptolabis) luteicosta** sp. n.

Mesonotum brownish black, the dorsopleural region conspicuously pale; head obscure yellow; halteres pale yellow; tips of femora and coxae blackened; wings pale gray, the costal border conspicuously light yellow; macrotrichia in all cells beyond cord, lacking only in the extreme bases of cells R_3 to R_5; *Rs* very oblique.

Female.—Length, about 3 mm.; wing, 3.6 mm.

Rostrum and palpi brown. Antennae brown throughout; flagellar segments subcylindrical, becoming smaller outwardly, the verticils much longer than the segments. Head obscure yellow.

Mesonotum above chiefly brownish black, the praescutal interspaces paler; sides of praescutum, anterior lateral pretergites and dorsopleural membrane pale yellow. Pleura chiefly brownish black. Halteres pale yellow. Legs with the fore coxae blackened, remaining coxae pale; trochanters obscure yellow; femora brownish yellow, the tips narrowly brownish black; tibiae pale yellow, the extreme base and broad tips blackened; tarsi black, the proximal end of basitarsus paler. Wings with a pale gray tinge, the costal border clear light yellow; cord very narrowly seamed with brown; axilla more or less darkened; veins brown, *C*, *Sc* and *R* yellow. Macrotrichia in all cells beyond cord, lacking on basal third of R_2 and extreme bases of R_3, R_4 and R_5; a few trichia in outer ends of cells *Cu* and *1st A*. Venation: *Rs* very oblique, sinuous, cell R_1 roughly equilateral, with *Rs* slightly the longest element; *Rs* in direct alignment with R_5, the basal deflection of the latter obliterated; R_2 a little longer than R_{2+3} and in nearly transverse alignment with it; cell M_3 deep.

Abdomen dark brown, the ovipositor a trifle brighter.

HABITAT: Panama (Chiriqui). *Holotype*, ♀, Finca Parada, 4,450 ft., September 11, 1932 (Lawlor).

Closest to *Cryptolabis* (*Cryptolabis*) *luteiceps* Alex. (Chiapas, Mexico), differing especially in the larger size and more abundant trichia in the cells beyond cord. In *luteiceps*, these are much more sparse, lying only in the centers of the cells and occupying the distal two-thirds or less. In addition, cell R_1 in *luteiceps* is longer, so vein R_1 is the longest element of the nearly equilateral triangle.

29. **Molophilus (Molophilus) anerasta** sp. n.

Belongs to the *plagiatus* group; general coloration brownish black; antennae (♂) elongate, nodulose; halteres pale; male hypopygium with

the basal dististyle a simple slender rod, narrowed gradually to the acute apex, the surface smooth except for small punctures on basal half.

Male.—Length, about 4 mm.; wing, 4.2 mm.; antenna, about 1.6 mm.

Female.—Length, about 4.5 mm.; wing, 4.6 mm.

Rostrum and palpi black. Antennae black, the basal two segments and apices of the succeeding two or three segments paler; antennae (♂) relatively long and strongly nodulose, the dilated parts of the segments with long outspreading setae. Head dark brown.

Mesonotum and pleura dark brown, sparsely pruinose, the anterior lateral pretergites restrictedly whitish. Halteres pale, the knobs with yellow setae. Legs black, the trochanters and extreme bases of femora a trifle paler. Wings strongly tinged with blackish, the prearcular region a little more yellowish; veins and macrotrichia blackish. Venation: R_2 lying distad of *r-m;* vein *2nd A* long, ending opposite the basal fourth of petiole of cell M_3.

Abdomen, including hypopygium, black. Male hypopygium with the apical beak of basistyle very slender. Basal dististyle a simple rod, slender, gradually narrowed to an acute point, the basal half with small scattered setigerous punctures and tubercles, but without setulae as in *subtenebricosus*.

HABITAT: Panama (Chiriqui). *Holotype*, ♂, Finca Palo Alto, 4,700 ft., September 12, 1932 (Lawlor). *Allotype*, ♀, Finca Parada, 4,450 ft., September 12, 1932 (Lawlor).

The nearest allies, *Molophilus tenebricosus* Alex. and *M. subtenebricosus* Alex., both of Colombia, are readily told by the much stouter basal dististyle, with the surface roughened and setulose, and with the basal portion much enlarged.

30. **Molophilus (Molophilus) chiriquiensis** sp. n.

Belongs to the *plagiatus* group; general coloration dark brownish gray; halteres yellow; wings pale grayish, with two conspicuous pale brown fasciae; male hypopygium with the outer dististyle bifid at apex; basal dististyle with a row of about nine spines on outer margin beyond midlength and a group of more slender spinous setae on inner face at near one-third the length.

Male.—Length, about 3.8 mm.; wing, 4.5 mm.

Rostrum and palpi black. Antennae broken. Head gray.

Mesonotum brownish gray to plumbeous, the anterior lateral pretergites very narrowly and inconspicuously paler; median region of scutum and base of scutellum more testaceous. Pleura plumbeous. Halteres pale yellow. Legs with the coxae brownish yellow; trochanters yellow; femora brown, the bases extensively obscure yellow; trochanters obscure yellow, darkened at tips; tarsi brown; vestiture of legs chiefly denuded. Wings pale grayish, with two conspicuous pale brown fasciae, the first transverse, at level of *Rs*, the second more oblique, at level of cord; veins pale brown, darker in the shaded areas. Venation: R_2 lying about twice its length beyond level of *r-m*, R_{2+3} thus being nearly

three times R_{4+5}; vein *2nd A* ending about opposite the cephalic end of *m-cu*.

Abdomen, including hypopygium, dark brown. Male hypopygium with the apical beak of basistyle slender. Outer dististyle bifid at apex, the inner arm a little longer and more acute at tip. Basal dististyle relatively slender, gradually narrowed to a long straight point; outer margin just beyond midlength with a crest of nine conspicuous spines arranged in a chiefly single row; at about the basal third of style on inner face with a group of more slender spinous setae, the uppermost shorter and more spinelike.

HABITAT: Panama (Chiriqui). *Holotype*, ♂, Finca Lerida, 6,700 ft., September 16, 1932 (Lawlor).

The structure of the basal dististyle of the male hypopygium is generally similar to that of *Molophilus perseus* Alex. (Colombia), but in other regards the two flies are quite distinct. I do not have a male of *perseus* and must trust the original figures as made by myself a score of years ago (Jour. N. Y. Ent. Soc., 21; Pl. 6, Figs. 4, 5; 1913). If these latter are correct, the simple U-shaped outer dististyle of *perseus* is entirely different from the forked condition in the present fly. In general appearance, *chiriquiensis* is darker in color, smaller in size, and is readily told by the two dark-colored fasciae traversing the wing-disk.

BOOK NOTICE

INSECTS AND DISEASES OF ORNAMENTAL TREES AND SHRUBS, by E. P. FELT AND W. H. RANKIN. Pages i-xix and 1-507, 243 text figures. 1932. Published by the Macmillan Company, New York. Price, $5.00.

"This volume is a combination of the senior author's 'Manual of Tree and Shrub Insects' and the junior author's 'Manual of Tree and Shrub Diseases,' entirely rewritten and brought down to date. The book is divided into two parts. The whole arrangement is as follows: Part I (pp. 1–131), General: Insects, Fungi, Injuries and Treatments. Chapter I, Insects and Their Depredations; II, Fungi and Their Depredations; III, Insecticides and Fungicides; IV, Injuries other than those caused by Organisms. Part II (pp. 133–484), Alphabetic Arrangement of Trees and Shrubs with Accounts of the Associated Insects and Fungi. In Part II seventy-two trees and shrubs are listed under each of which its pests and diseases are described. The index covers pages 485–507. The volume has been planned as a horticulturalists handbook and is without bibliography or footnote references.

A survey of the book impresses one with the mere smattering of effective remedies available for the treatment of trees and shrubs affected by insects and disease. Applied forest entomology and phytopathology have not made the advances that these sciences have made in other fields.

Emphasis is put on the various problems peculiar to raising trees and shrubs in city parks and yards, such as pruning injuries, gas injuries, etc. The whole problem of city forestry has such an artificial setting that the problems are many of them very different from those with the same species in their natural habitats and much more baffling because of the unnaturalness of the set up.

The illustrations are excellent. The cloth binding gives a book that can stand the hard usage meted out to a field-man's guide.—C. H. K.

THE ROBBER FLIES OF TEXAS

(Diptera, Asilidae)[1]

S. W. Bromley,
Texas Agricultural Experiment Station

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INTRODUCTION

Texas not only has the distinction of being the largest state in the Union, but also appears to be proportionately endowed in other respects. There is a tremendous variety of both flora and fauna. The Dipterous family Asilidae, with which this paper deals, is represented to an extent unparalleled either in species or in individuals by any other region in the country. The list following, which must be considered as only preliminary, comprises 161 species. If contrasted with the author's recent list for Ohio of 65 species, an idea of the wealth of the Texas asilid fauna may be gained. In addition, Texas may boast of some of the largest species of these predacious flies occurring in North America. *Microstylum morosum* (Pl. 1, Fig. 9), (No. 30 in the list), originally described from Dallas, reaches a length of 50 mm.; *Promachus giganteus* (Pl. 1, Fig. 2), (No. 111) from the western part of the state, may exceed a length of 47 mm.; while in actual bulk there are probably no species in North America greater than the large bumblebee-like *Bombomima lata* (No. 88), the type locality of which is Galveston, or the huge *Mallophora belzebul* (No. 100), from the Uvalde region. The latter species also occurs in Mexico and Brazil.

[1]Contribution No. 261, Tech. Series, Division of Entomology.

In the Brazos County region, there are four distinct groups of asilids, according to the order of there appearance. The first, or spring forms, begin to appear in March and continue through May. Examples of this group are *Bombomima flavicollis*, *B. macquartii*, *Asilus notatus*, and *Proctacanthus brevipennis*. June is the hey-day for the majority of the species, most of the second group, or early summer forms, as *Promachus bastardi*, *P. texanus*, *Saropogon dispar*, and many others, appearing in this month. August and early September form a hiatus between the peak of abundance of the second group and the appearance of the autumn species, which comprise the third group. The fourth group consists of those which occur generally throughout the season from spring to autumn. Characteristic species of the third, or autumn group, which appear after the late summer rains, are *Proctacanthus milbertii*, *Erax rufibarbis*, and *A. prairiensis*. Among those of the fourth group may be mentioned *Diogmites symmachus*, *Erax interruptus*, *Erax aestuans*, *E. barbatus*, *Stichopogon trifasciatus*, and *Proctacanthella cacopiloga*.

The larval stages of most of the Asilidae are passed in the soil where the food of a number of species consists of the larvae of scaraboeid beetles, particularly *Phyllophaga*. Most of the Laphriinae pass the immature stages in dead wood, such as logs or stumps, where several species have been recorded as feeding on the larvae of Coleoptera frequenting such places. The life cycle, so far as is known, is never under a year, and some are reported as having a three-year cycle.

The economic status of the family as a whole is rather conflicting. Some species undoubtedly have a profound effect on reducing the number of white grubs due to the larval feeding habits, while the adults of some species prey on grasshoppers and destructive moths. On the other hand, the adults of certain species are given to feeding on honey bees and in some regions may be distinctly injurious when considered from this standpoint.

Several species have caused concern among Texas apiarists because of their bee-killing habits. Such species are commonly known as "bee-catchers."[2] Those most usually implicated are the two species of *Diogmites* (*Deromyia*), *angustipennis* and

[2]Other common names listed by Mr. H. B. Parks (Gleanings in Bee Culture, March, 1924, p. 161) are "bee-hawk," "bee-killer," and "dragon-fly."

symmachus; and *Saropogon dispar*. All three frequently abound in bee-yards, and their depredations on the virgin queens, particularly, cause losses to the owners.

Saropogon dispar is by far the most noxious species in bee-yards in the San Antonio region. Mr. H. B. Parks suggests as a method of control, keeping the apiary free from grass and bushes in which the flies lurk, and killing them, when numerous, with wooden paddles or catching them with a net.

Among the more common prey of the Hymenoptera-feeding species are the different species of paper wasps, *Polistes*. Representatives of the genus *Vespa*, a common prey of many eastern species, are rather scarce in Texas, *V. maculata* apparently not occurring west of the Trinity river and *V. carolina* and *V. maculifrons* being rare particularly in the western part of the state, but their place is taken by different species of *Polistes*, many of which are very abundant. *P. annularis*, is one of the most common, as well as the largest form, and frequently falls prey to asilids. The following species have been taken with *P. annularis* as prey in Texas: *Diogmites symmachus; Saropogon dispar; Mallophora orcina; Promachus hinei;* and *Proctacanthus rufus*.

The region most intensively collected is the College Station area. Most of the writer's studies have been conducted here, and the general discussion of most of the species considered in the annotated list refer to their status in this location. Date and prey records, unless otherwise indicated, refer to this locality. This paper also includes those species recorded by Hine (Occasional Paper of the Museum of Zoology, University of Michigan, No. 61, pp. 1–7, June 29, 1918) from the Trans-Pecos region, collected by F. M. Gaige during the Bryant-Walker Expedition, 1916.

The types of the new species, unless otherwise indicated, are at the Texas Agricultural Experiment Station, Division of Entomology.

Erax is the most plentifully represented genus, 30 species being listed. *Lasiopogon* and *Cyrtopogon*, which swell the asilid lists in California and the Northwest, are unrepresented in Texas; while *Asilus*, an abundant genus in many parts of North America, is only poorly represented here.

Some asilids have the eyes brilliant green in life. This coloration does not persist after death. Among the species

where this was noted are: *Microstylum morosum; Diogmites symmachus, texanus,* and *angustipennis; Promachus texanus; Lampria rubriventris;* and *Psilocurus nudiusculus.*

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To Dr. S. W. Bilsing and Professors H. G. Johnston and V. A. Little, of the Department of Entomology, Texas A. & M. College, is credit due for information and specimens for study; while Dr. D. B. Casteel of Texas University, Austin, Mr. C. H. Curran, of the American Museum of Natural History, Mr. E. T. Cresson, Jr., of the Academy of Natural Sciences of Philadelphia, and Dr. J. M. Aldrich, of the United States National Museum, all furnished either specimens or records from their respective institutions. The writer is also greatly indebted to Dr. R. H. Painter of the Kansas Agricultural College; Dr. F. R. Cole, Whittier, California; Mr. Joseph Wilcox, Puyallup, Washington; and Mr. J. W. Monk, Donna, Texas, for specimens and information. For all these contributions, the writer is very grateful.

EXPLANATION OF ABBREVIATIONS

A.M.N.H.—American Museum of Natural History.
A.N.S.P.—Academy of Natural Sciences of Philadelphia.
C^1, C^2, C^3—First, second, and third coxae.
F^1, F^2, F^3—First, second, and third femora.
F.F.B.—F. F. Bibby.
H.B.P.—H. B. Parks.
H.J.R.—H. J. Reinhard.
M.A.E.S.C.—Massachusetts Agricultural Experiment Station Collection.
P.B.T.—P. B. Tate.
R.H.P.—R. H. Painter.
R.K.F.—R. K. Fletcher.
S.E.McG.—S. E. McGregor.
S.W.B.—S. W. Bromley.
Tb^1, Tb^2, Tb^3—First, second, and third tibiae.
U.T.—University of Texas.
W.C.O'D.—W. C. O'Dowd.

KEYS

(NOTE.—The numbers before the specific names in the key indicate the position of the species in the Annotated List following. The names without numbers are of those species which have not as yet been taken in Texas.)

KEY TO SUBFAMILIES

1. Marginal cell open 2
   Marginal cell closed 3
2. Palpi one-jointed; small, slender species; antennae with slender terminal arista. (Page 78). ..... I. **Leptogastrinae**
   Palpi two-jointed; antennae not aristate (except in **Damalis**), but may or may not bear a thickened terminal style. (Page 78) ..... II. **Dasypogoninae**
3. Antennae never aristate; palpi two-jointed. (Page 79) ..... III. **Laphriinae**
   Antennae with a slender terminal arista; palpi one-jointed. (Page 80) ..... IV. **Asilinae**

KEY TO GENERA

I. LEPTOGASTRINAE

1. Empodia absent. (Page 80) ..... **Psilonyx**
2. Empodia present. (Page 80) ..... **Leptogaster**

II. DASYPOGONINAE

Key to Tribes

1. Front tibia with a subterminal claw-like spur. (Page 79) ..... (b) **Acanthocnemini**
   Front tibia without a subterminal claw-like spur 2
2. Apparently 7 abdominal segments in male, 8 in female, (except in **Ablautus**, where only 5 or 6 segments in male are visible from above. (Page 78) ..... (a) **Eremocnemini**
   Apparently only 6 abdominal segments in male. (Page 79) ..... (c) **Prytaniini**

(a) EREMOCNEMINI

1. Only four posterior cells present, front very broad above; very small species. (Page 80) ..... **Townsendia**
   Five posterior cells present 2
2. Pulvilli vestigial or wanting, third antennal segment with a short, thickened style; rather stout, small species. (Page 80) ..... **Ablautus**
   Pulvilli normal 3
3. Head narrow, about as high as broad; face narrow above, broader and swollen below, in large part covered with hair; medium to large elongate species 4
   Head broader than high 5
4. Antennae with a terminal style; small-headed, rather slender asilus-like species. (Page 81). ..... **Stenopogon**
   Antennae without a style; third segment long; fourth posterior cell closed before the border of the wing; black species, with or without red or yellow on the abdomen. (Page 81) ..... **Ospriocerus**
5. Fourth posterior cell closed before the border of the wing 6
   Fourth posterior cell open, rarely nearly closed 9
6. Antennae elongate, apparently of five segments 10
   Antennae not elongate, composed of 3 segments, without terminal style 7
7. Face bare except on oral margin, very large, long-necked, long-beaked species 8
   Face pilose or hairy, more convex, third antennal segment with an excision on inner half. (Page 81). ..... **Dizonias**
8. Anterior intercalary vein continuous or nearly so with the fourth vein, the last section of the latter oblique, closing or much narrowing the first posterior cell. (Page 81) ..... **Microstylum**
   Last section of the fourth vein continuous with the preceding section, the first posterior cell not closed or narrowed ..... **Archilestris** Loew
9. Antennae elongate, composed of five segments; nearly bare species 10
   Antennae shorter, composed of 3 segments, without a short or slender style 12
10. First segment of antennae about three times the length of second, third elongate, the fourth and fifth of nearly equal length; third and fourth segment at tip with two lobes or processes, reaching to about the middle of the following segment ..... **Myielaphus** Bigot
    First and second segments of nearly equal length, the third elongate, fourth short, the third and fourth segment not lobed at tip 11
11. Terminal segment of antennae short, rounded, naked, on the outer side with a projection bearing a short, forward-directed bristle ..... **Ceraturgopsis** Johnson
    Terminal segment of antennae elongate and densely microscopically pubescent. (Page 81). ..... **Ceraturgus**
12. Antennal style short and thick, obtuse; antennae more or less elongate 13
    Antennal style small, slenderer than third segment; antennae usually shorter; face flattened or gently convex 15
13. Nearly bare species; face flattened, bare, except below, small or rather small species, polished or metallic black, with narrow or cylindrical abdomen and large wings 14
    Pilose species, bristles few and hair-like; antennae inserted on a convexity, the facial profile thence receding to the tubercle which is situated on the lower part of the face; abdomen moderately stout; head narrow ..... **Dicolonus** Loew

14. All the tibiae and hind femora with short, strong bristles ..... **Echthodopa** Loew
Hind femora without such bristles ..... **Dioctria** Meigen
15. Abdomen elongate; front broad anteriorly, narrowed behind. (Page 81) ..... **Plesiomma**
Front not narrowed behind 16
16. Hind tibiae toward tip, and their metatarsi, much thickened 17
Hind tibiae toward tip, and their metatarsi, not thickened 18
17. Head much broader than high, transverse, "goggle-like;" abdomen short, wings large. (Page 81), **Holcocephala**
Head only moderately broader than high, not "spectacle-like." (Page 82) ..... **Holopogon**
18. Style of antennae long and slender, at least one-half as long as the slender, tapering, third segment; quite stout species 19
Style of antennae not one-half so long as third segment and stouter than above 20
19. Abdomen with thick recumbent pile above; very thickly pilose species ..... **Pycnopogon** Loew
Less pilose species. (Page 82) ..... **Heteropogon**
20. Front noticeably widened above; middle tibiae without two terminal inwardly directed spines, third antennal segment rather elongate. (Page 82) ..... **Stichopogon**
Front not widened above; middle tibiae with two terminal inwardly directed spines; abdomen cylindrical, wings nearly hyaline ..... **Chrysoceria** Williston

(b) Acanthocnemini

1. Face bare with bristles on oral margin, in profile straight or concave, the oral margin most prominent 2
Face convex below, oral margin not prominent, more or less covered with hair 4
2. Posterior pulvilli much shorter than the elongate claws; scutellum without bristles, **Blepharepium** Rondani
Posterior pulvilli not much shorter than claws 3
3. Fourth posterior cell closed a considerable distance before the margin of the wing. (Page 82), **Diogmites**[3]
Fourth posterior cell open or closed at margin. (Page 82) ..... **Saropogon**
4. Third antennal segment more or less dilated; the style very short, the thoracic dorsum when viewed from front with four longitudinal rows of long bristles, one each on either side of the median stripe and on the lateral margins ..... **Lestomyia** Williston
Third segment slender, elongate 5
5. Abdomen finely punctate; third antennal segment elongate, notched on upper side near middle where it bears a forward directed spine. (Page 83) ..... **Taracticus**
Abdomen smooth 6
6. Abdomen flattened; seventh and eighth abdominal segments in male not visible from above. (Page 83) ..... **Nicocles**
Abdomen not flattened or expanded. (Page 83) ..... **Cophura**

(c) Prytaniini

1. Scutellum with a few stout bristles; veins at outer ends of discal and fourth posterior cells parallel or nearly so. (Page 83) ..... **Psilocurus**
Scutellum without stout bristles; sometimes densely pilose or with weaker hair-like bristles forming a fringe on the posterior margin or with both 2
2. First posterior cell wide open, scarcely narrowed; face broad, vertex deeply excavated; style of antennae thick, distinctly two-jointed. (Page 83) ..... **Laphystia**
First posterior cell closed or nearly so; face narrower, more protuberant below; scutellum with a fringe of weak bristles ..... **Triclis** Loew

III. LAPHRIINAE

1. Veins at distal ends of discal and fourth posterior cells parallel or continuous in the same straight line; body punctulate 2
Veins at distal ends of the discal and fourth posterior cells very distinctly angulated and not parallel .. 3
2. First antennal joint more than twice the length of the second; front much widened above, **Cerotainia** Schiner
First joint not more than twice as long as second, front not widened above. (Page 83) ..... **Atomosia**
3. Proboscis slightly pointed and upturned at tip in profile; palpi broadened and truncate at tip 4
Proboscis truncate, long; palpi slender and rounded at tip 5
4. Three submarginal cells ..... **Pogonosoma** Rondani
Two submarginal cells. (Page 84) ..... **Andrenosoma**
5. Bare species, hind femora usually with tubercles below, tips of antennae slightly curled. (Page 84), **Lampria**
More pilose species; no tubercles on hind femora; antennae straight 6
6. Densely pilose species, abdomen short and broad, generally broader beyond the middle. (Page 84) ..... **Bombomima**
Less pilose, the hairs short; abdomen more cylindrical ..... **Laphria**

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[3]Our North American species generally placed in *Deromyia* are not congeneric with the South American *gracilis* Phillipi (Chile), a *Leptogaster*-like species related to the African genus *Neolaparus*. Engel refers our North American species to *Diogmites* Loew, the genotype of which is *D. platypterus* Loew, a procedure which I am following.

IV. ASILINAE

1. Antennal arista pectinate below. (Page 84) ..... **Ommatius**
   Antennal arista bare 2
2. Posterior branch of third vein curves forward to meet the costa at or before the tip of the wing; or the anterior branch of the third vein angulated near its origin, with stump, or both 3
   Posterior branch of third vein terminates beyond tip of wing; anterior branch without a stump 5
3. Ovipositor cylindrical, with a terminal circlet of spines 4
   Ovipositor laterally compressed; without circlet of spines. (Page 85) ..... **Erax**
4. Abdomen shorter than wings. (Page 85) ..... **Eccritosia**
   Abdomen longer than wings. (Page 85) ..... **Proctacanthus**
5. Three submarginal cells 6
   Two submarginal cells 8
6. Claws blunt at tip 7
   Claws pointed at tip; abdomen longer than wings; body thinly pilose. (Page 84) ..... **Promachus**
7. Stout, thickly pilose species; genitalia very small and inconspicuous in both sexes. (Page 84) ..... **Mallophora**
   Slenderer, thinly pilose species, resembling **Promachus,** the ovipositor elongate and male claspers similar to **Promachus**. (Page 84) ..... **Promachina**
8. "Metanotal" slopes bare; ovipositor cylindrical and with a terminal circlet of spines. (Page 87) ..... **Proctacanthella**
   "Metanotal" slopes hairy 9
9. Ovipositor without bristles. (Page 87) ..... **Asilus** Linnaeus
   Ovipositor with a few upturned bristles. (Page 87) ..... **Philonicus** Loew

KEYS TO SPECIES

(NOTE.—The numbers in parentheses preceding the species names refer to the numbered annotated list following the keys.)

Psilonyx Aldrich

1. Hind femora with one large yellow band on its swollen portion; hind tibiae five-banded; second posterior cell hardly longer than the third (8–11 mm.) ..... **annulatus** Say
   Hind femora with two distinct yellow bands on its swollen portion; hind tibiae four-banded; second posterior cell considerably longer than the third (12 mm.) ..... (9) **schaefferi**

Leptogaster Meigen (after Back)

1. Anterior intercalary vein forming a distinct angle with that portion of the posterior cross vein that closes behind the second posterior cell 2
   Anterior intercalary vein not forming a distinct angle, but appears more or less continuous with that portion of the posterior cross vein that closes behind the second posterior cell 3
2. Dorsum of thorax with median and two lateral stripes polished black (sometimes vittae reddish); ground color of thorax elsewhere pinkish but covered thinly with a white bloom (9–13 mm.). (6) **virgatus**
   Dorsum of thorax not so; abdomen yellow, legs yellowish, posterior margins of abdominal segments narrowly black or blackish (10–12 mm.) ..... (2) **incisuralis**
3. Fourth posterior cell sessile or subsessile; antennae wholly yellow, third segment oval, short; dark brown species; hind femora with a conspicuous dark brown ring (10 mm.) ..... (1) **brevicornis**
   Fourth posterior cell petiolate 4
4. Dorsum of thorax with median and two lateral stripes polished black (sometimes vittae reddish); ground color of thorax elsewhere pinkish but covered thinly with a white bloom (9–13 mm.). (6) **virgatus**
   Dorsum of thorax not as above 5
5. Hind femora and tibiae very slender; wings hyaline sometimes clouded at base (9.2–10 mm.). (5) **tenuipes**
   Hind tibia stout, large species (12–14.5 mm.); dorsum of thorax brown pollinose, contrasting with the white bloom of pleura; abdomen brown pollinose, not ringed, legs yellow ..... (8) **murinus**
   Hind femora and tibiae normal 6
6. Grayish yellow species 7
   Pale reddish brown, abdomen ringed; legs with light brownish markings; third antennal segment entirely reddish, arista black (10–13 mm.) ..... (7) **texanus**
7. Antennae rufous; third segment black on distal portion; abdomen nearly uniformly brownish black, grayish on sides; not ringed; legs with blackish markings (8–9 mm.) ..... (3) **eudicranus**
   Basal segments of antennae, the legs, and the abdomen yellowish, the posterior margins of the segments of the latter black or blackish (10–12 mm.) ..... (2) **incisuralis**

(**L. scapularis** Bigot was not included in the key It is described as being fuscous black; pleura and scapulae reddish, antennae black, fulvous at base; legs fulvous, posterior femora black ringed at apex, 14 mm.)

Townsendia Williston (after Back)

1. Head, thorax black, four shiny white spots on dorsum; abdomen except tip and legs reddish (3.5 mm) ..... (10) **pulcherrima**

Ablautus Loew (after Back)

1. Abdomen wholly black, femora black, tibiae reddish yellow (9 mm) ..... (12) **rufotibialis**
   Reddish species, lower part of pleura polished black; femora reddish yellow (7 mm) .. (11) **mcgregori**

Ospriocerus Loew (after Back)

1. Abdomen wholly black (17-18 mm) 2
   Abdomen largely reddish or yellowish 3
2. Body entirely black (17-18 mm) ..... **minos** Osten Sacken
   Mesonotum orange with median black spot, scutellum orange (14-15 mm) ..... (16) **parksi**
3. Venter of abdomen black 4
   Venter of abdomen largely yellowish or reddish (20-23 mm) ..... (17) **ventralis**
4. Abdomen with white pruinose spots 5
   Abdomen without white pruinose spots (13-19 mm) ..... (15) **abdominalis**
5. Males with thorax black, yellowish above with a central black spot (20 mm) ..... (14) **rhadamanthus**
   Females, thorax and legs either reddish chocolate colored or black, last two segments of abdomen black, wings and bristles black (21.5-22 mm) ..... (13) **eutrophus**

Stenopogon Loew

1. Third segment of antennae elongate, style usually short, sometimes longer and slenderer; first posterior cell generally open 2
   Third segment of antennae more oval, style bristle-like; first posterior cell more frequently closed 8
2. Decidedly black, with or without red on abdomen; the latter not obscured by grayish bloom; wings black 3
   Reddish; or if black, with abdomen obscured by bloom; wings reddish or brownish 4
3. Abdomen wholly polished black (16 mm) ..... (26) **nitens**
   Abdomen, except base and tip, reddish (14-20 mm) ..... (18) **aeacidinus**
4. Abdomen elongate, wings long 5
   Abdomen less elongate, wings shorter and quite broad 6
5. Third antennal segment about as long as first two together; reddish yellow, abdomen quite slender, subpolished; wings broader than in next species, uniformly brownish or blackish; bristles and hairs of entire body sordid white; those on vertex and legs more yellow (20-27 mm). (24) **subulatus**

   Third antennal segment almost twice as long as first two together; abdomen unusually slender, wings long and narrow; hairs and bristles yellowish; humeri, abdomen, and legs light reddish yellow; each femur with a basal black spot; thorax blackish; wings yellowish gray (17-20 mm). (25) **longulus**
6. Blackish, covered uniformly with grayish bloom (14 mm) ..... (27) **pumilus**
   Reddish (abdomen at least) 7
7. Wings brownish with considerable reddish toward base 8
   Wings darker, not reddish; large robust species (22 mm) ..... (22) **tenebrosus**
8. Thorax grayish pruinose; bristles whitish (14-15 mm) ..... **consanguineus** Loew
   Thorax yellowish pruinose; larger and more robust; wings broader, femora stouter; bristles more golden (18-19 mm) ..... (23) **latipennis**
9. First posterior cell closed 10
   First posterior cell open; reddish with black margins on thorax; wings black with reddish toward base (18-23 mm) ..... (19) **texanus**
10. Wholly and densely grayish white pruinose; wings hyaline; small (15 mm), slender species. (20) **cinerascens**

    Not completely and densely whitish pruinose 11
11. Large species (20-28 mm); chamois-leather yellow, abdomen long and slender, without black fasciae ..... (21) **helvolus**
    Smaller species (15-19 mm); thorax grayish yellow pollinose, contrasting with abdomen which is gray pollinose ..... **coyote** Bromley

Microstylum Macquart (after Back)

1. Wings more or less milky white; head and thoracic dorsum evenly whitish pruinose (30-34 mm). (29) **galactodes**

   Wings blackish or brownish; bloom of thoracic dorsum prominent only on lateral margins, (35-50 mm) ..... (30) **marosum**

Dizonias Loew

1. Dimorphic species (16-28 mm), males entirely black with or without the apical portion of the abdomen reddish, but usually with two white pruinose fasciae near the base; the female yellowish or brownish red with more or less black in the form of bands on the abdomen ..... (28) **tristis**

Ceraturgus Wiedemann (after Back)

1. Terminal segment of antennae nearly or quite linear; abdominal segments 1-5 with grayish posterior cross band; pleura wholly grayish pruinose; black species, bloom of head and thorax grayish, rather pilose species (20 mm) ..... (31) **dimidiatus**

Plesiomma Macquart (after Back)

1. Wholly brownish yellow; posterior margins of last abdominal segments occasionally slightly darkened; wings blackish; costal portion of cells much lighter (19 mm) ..... (32) **unicolor**

Holcocephala Jaennicke (after Back)

1. Abdomen reddish yellow; wings broad, blackish, lighter at apex; legs reddish, tips of all tibiae and tarsal segments blackish (4.5-7.0 mm) ..... (33) **abdominalis**
   Abdomen brownish or blackish 2
2. Abdomen slender, coarctate; posterior margins of 1-3 grayish pruinose; black species, grayish pruinose (8-9 mm) ..... (34) **calva**
   Abdomen broad, flattened; robust, black species; vestiture light golden brown (5-7 mm) ..(35) **bullata**

Holopogon Loew

1. Wings deep black, except at tip 2
   Wings not deep black 4
2. Legs black 3
   Femora shining black; tibiae and tarsi reddish (5–7 mm) ..... (36) **texanus**
3. Black; trace of golden pruinose spot on humeral angles; paler bloom on pleura (6 mm) ..... (39) **atripennis**
   Mesonotum with three confluent brownish black stripes; black, unusually broad, robust species, (6 mm) ..... (38) **lautus**
4. Legs black; pile of thoracic dorsum chiefly black; white in varying amounts on anterior and posterior portions (6 mm) ..... (37) **phaeonotus**
   Wings hyaline; body black; tibiae and tarsi reddish (6–8 mm) ..... (40) **saowi**

Heteropogon Loew (after Back)

1. Abdominal segments 1–4 black 2
   Abdominal segments 3–6 with reddish 3
2. Wings with apical half blackish; tibiae and tarsi brown or reddish; apex of abdomen reddish (9–12 mm) ..... (45) **phoenicurus**
   Wings hyaline; tibiae black; male with brush of hairs on anterior side of middle tibiae; very pilose species (10–12 mm) ..... (41) **johnsoni**
   Wings usually hyaline, sometimes the cross veins and junctures of others lightly clouded with brown; tibiae reddish; bloom of abdomen confined to apices of segments; front tarsi of male completely, densely, clothed above with appressed white pile (9–11.5 mm) ..... (42) **lautus**
   Bloom of abdomen extending on the base of the segments; head, thorax, and abdomen conspicuously partly white pilose (13–15 mm) ..... (43) **senilis**
3. Wings smoky-brown, darkest on apical half; head, antennae, and thorax, black; front metatarsi of male with appressed white pile (13–16 mm) ..... (44) **patruelis**

Stichopogon Loew (=**Neopogon** Bezzi)

1. Scutellum with well-developed pile or bristles 2
   Scutellum without well-developed pile or bristles 3
2. Head and thorax blackish; abdomen and legs yellowish (3 mm) ..... **fragilis** Back
   Wholly black; everywhere silvery-white pollinose (6–8 mm) ..... **argenteus** Say
3. Legs black, white pollinose; abdomen black, trifasciate with white (9–15 mm) ..... (46) **trifasciatus**
   Bases at least of tibiae reddish 4
4. Abdomen largely reddish, anterior and posterior margins of segments 1–4 narrowly white pruinose, the anterior margins of 3–4 more prominently so; segments 1–4 with sides whitish pruinose (6–8 mm) ..... (47) **abdominalis**
   Abdomen white pollinose, segments 1–7 with triangular black spots; dorsum with golden brown bloom (8–11 mm) ..... (48) **colei**

Saropogon Loew (after Curran)

1. Scutellum with normally long bristles 2
   Scutellum with short denticles, disk with short hairs; abdomen short, stout; black, the female may have abdomen reddish (9–12 mm) ..... (49) **abbreviatus**
2. Wings brownish or blackish 3
   Wings hyaline, scutellar bristles four, abdomen slender, reddish, genitalia and venter black, (14–16 mm) ..... (50) **coquillettii**
3. Scutellum with two bristles 4
   Scutellum with four bristles 5
4. Legs uniformly reddish, palpi black (20–23 mm) ..... (52) **pritchardi**
   Legs reddish with femora black above, base of palpi black (27 mm) ..... **birdi** Curran
5. Bristles of coxae white or yellowish; femora with reddish stripe in front; antennae reddish (except style) (20–29 mm) ..... (54) **dispar**
   Bristles of coxae black; antennae black (13.5–15.0 mm) ..... (51) **combustus**
   Large (24–27 mm) reddish species (both sexes); legs entirely reddish ..... (53) **fletcher**

Diogmites Loew (after Back)

1. Dorsum of thorax with three velvety black stripes 8
   Dorsum of thorax without three velvety black stripes (although sometimes dark) 2
2. Wings blackish, brownish, or yellowish 3
   Wings more or less hyaline 5
3. Abdomen black; thorax brownish, legs yellowish (16–20 mm) ..... **platypterus** Loew
   Abdomen reddish or yellowish 4
4. Very large species (30–35 mm); wings yellowish or yellowish brown; Mexican species ..... **bigoti** Bellardi
   Smaller species (19–22 mm); wings brownish or blackish; abdomen and legs yellowish, thoracic dorsum brown with four thin lines and additional spots of darker color ..... (56) **sallei**
5. Abdomen reddish; last two segments and anterior margins of the other segments and venter black; abdomen very stout (17.6–20.5 mm) ..... (55) **hypomelas**
   Abdomen reddish or black, but never with the above combination of color; bristles of pronotum yellowish 6
6. Palpi black; small species (15–17 mm); reddish, abdomen almost wholly pruinose without black spots ..... (57) **perplexus**
   Palpi reddish yellow; abdomen with black spots along sides 7
7. Brownish yellow, rather robust species; portion of wings lightly grayish greater as a rule than in the following; thoracic dorsum more olivaceous and stripes usually darker; abdomen stouter, wider at base; male genitalia with many black hairs; ovipositor broader as a rule than in **symmachus** (17–27 mm) ..... (59) **angustipennis**
   Reddish yellow, slightly slenderer; male genitalia with mostly reddish hairs; ovipositor longer and slenderer (18–32 mm) ..... (60) **symmachus**

8. Wings hyaline; abdomen long, coarctate; the median thoracic stripe fading into reddish toward the pronotum (19–25 mm).....(62) **neoternatus**
Wings hyaline; abdomen not coarctate, with a black line at each side of segments, median thoracic stripe fading into reddish anteriorly (14–17 mm).....(61) **misellus**
Wings blackish; abdomen flattened and shorter, not coarctate; median thoracic stripe black to pronotum (18–23 mm).....(58) **texanus**

Taracticus Loew (after Back)

1. Black, wings hyaline; halteres, femora, tibiae except apices of hind pair, and bases of all tarsal segments yellow; abdomen punctate with eight white pruinose spots; thorax with golden pruinose stripes (6–8.5 mm).....(63) **octopunctatus**

Cophura Osten Sacken (after Back)

1. Reddish species, mesonotal stripes brownish; legs reddish, wings dark, with a clear spot on outer costal margin (6–9.8 mm).....(65) **bella**
Black species..... 2
2. Abdomen not wholly pollinose, basal half of tibiae reddish yellow, abdominal segments brownish pollinose anteriorly, anal cell narrowly open (8–10 mm).....(66) **texana**
Abdomen grayish pollinose on first five segments, tarsi black, antennal style slightly longer than 2nd antennal segment; scutellum with three pairs of marginal bristles (7.5 mm).....(67) **lutzi**

Nicocles Jaennicke

1. Third and fourth abdominal segments wholly black, antennal style half as long as third segment; mesonotum brownish pollinose, legs reddish, the femora banded with black apically; wings clouded in spots beyond the middle, these cloudings not filling the first and second posterior cells (9 mm).....(64) **reinhardi**

Laphystia Loew (after Curran)

1. Posterior femora reddish on basal half or more..... 2
Posterior femora reddish on less than the basal third..... 4
2. Pollinose bands on at least second and third abdominal segments entirely, or practically so, at most very narrowly interrupted..... 6
Pollinose bands interrupted by at least the length of one spot..... 3
3. Middle femora black with basal fourth and apex reddish (9.5–10.5 mm).....(75) **notata**
Middle femora reddish with apical fourth black (11–11.5 mm)..... **varipes** Curran
4. All the abdominal segments with entire pollinose cross bands; mesonotum with erect hair..... 5
Bands on fourth and fifth segments interrupted; middle femora reddish at base (9.5–10.5 mm).....(75) **notata**
5. The abdominal pollen leaves only a black triangle in the middle of the bases of the third to seventh segments.....(74) **opaca**
Third to seventh segments shiny black on basal half except laterally (9–11.5 mm).....(76) **texensis**
6. Abdomen reddish on apical half at least beneath the pollinose spots..... 7
Abdomen black in ground color (8–11 mm).....(73) **sexfasciata**
7. Abdomen brownish red on more than apical half; not paler beneath the pollinose fasciae (10 mm).....**limatula** Coquillett

Psilocurus Loew

1. First antennal segment mostly yellow; males blackish, females brownish or yellowish; generally two, sometimes four, scutellar bristles; legs partly blackish and partly reddish (7–8 mm).....(68) **nudiusculus**
Antennae wholly black..... 2
2. Legs black in both sexes; third antennal joint considerably shorter than first two together, ovate with a minute style; two scutellar bristles (9 mm).....**caudatus** Williston
Legs entirely black in male, entirely reddish yellow in female; two or four bristles on scutellum; third antennal segment as long as, or slightly longer, than the first two together, linear; two or four scutellar bristles (7–8 mm).....(71) **modestus**
Legs partly black and partly reddish..... 3
3. Femora red beneath; base of tibiae yellow; third antennal segment twice as long as wide, tapering from near the base, the brown sensory area covering most of the inner surface; four scutellar bristles, large, robust black species (9–10 mm).....(69) **birdi**
Two scutellar bristles in male, four in female; antennal third segment ovate, about the length of the first two; legs black, undersides of femora red; smaller and not as robust as **birdi** (7–9 mm).....(70) **puellus**

Atomosia Macquart (after Curran)

1. Anterior femora and tibiae not wholly pale yellow..... 2
Anterior femora and tibiae wholly pale yellow..... 5
2. Hair of face (females with hair of face sometimes white, but hairs of palpi black) and palpi wholly black (4–6 mm).....(83) **melanopogon**
Hair of face and palpi yellow or white..... 3
3. Scutellum with four bristles..... 4
Scutellum with two bristles; first antennal segment more than twice as long as second (5–6 mm).....(80) **glabrata**
4. Posterior femora reddish with apical half black, front and face white pollinose (5–6 mm)..(80) **glabrata**
Posterior femora blackish with only base and apex reddish brown.....10
5. Posterior calli partly or wholly reddish yellow..... 7
Posterior calli black..... 6
6. Posterior tibiae wholly yellow (4–6 mm).....(81) **sayii**
Posterior tibiae broadly black at apex; only apical tarsal segment brownish; legs reddish (6–8 mm).....(78) **rufipes**

7. Apical third of hind tibiae brownish, femora wholly pale; apical tarsal segment brownish (6–8 mm).....(78) **rufipes**
Only apical segment of tarsi brown.....8
8. Posterior femora brownish apically (7 mm).....(82) **soror**
Posterior femora wholly reddish or yellowish.....9
9. Posterior tibiae wholly yellow (6 mm).....(79) **mucida**
Posterior tibiae with apex broadly brown (8 mm).....(84) **punctifera**
10. Ocellar tubercle with two black bristles and two white hairs (4–6 mm).....(83) **melanopogon**
Ocellar tubercle with only two black bristles; apical tarsal segment black-haired (5–8 mm).....(77) **puella**

Laphria Meigen

1. Disk of thoracic dorsum black except for a central pair of yellow spots; general color of pubescence old gold; legs yellowish (17–25 mm).....(86) **saffrana**

Bombomima Enderlein

1. Abdomen black-haired; scutellum and thoracic disk and upper part of mystax yellow-haired; (11–19 mm).....(87) **flavicollis**
Abdomen with considerable yellow hair.....2
2. First abdominal segment yellow-haired, scutellum black-haired; tb2 yellow-haired (22–27 mm).....(89) **macquartii**
First abdominal segment black-haired; legs black-haired; ground color of thorax reddish; light hairs may be reddish or brownish instead of yellow; large robust species (30–40 mm).....(88) **lata**
First abdominal segment black-haired; legs black-haired; vestiture of head completely black (19 mm).....(90) **nigella**

Lampria Macquart

1. Head golden haired; tb1 and tb2 yellowish; thoracic dorsum golden pruinose; abdomen yellowish, darker posteriorly (9–21 mm).....(92) **rubriventris**
Head black and white haired; tb1 and tb2 black; thoracic dorsum with scattered whitish down; abdomen coral red (9–18 mm).....(91) **bicolor**

Andrenosoma Rondani

1. Abdomen completely yellow or reddish yellow.....2
Abdomen at least partly blackish.....3
2. Antennae partly reddish, thorax reddish; legs largely black (11–13 mm).....(93) **abdominalis**
Antennae black, thorax black (12 mm).....**similis** Brown
Antennae partly reddish; thorax reddish; legs completely black (12 mm). (California).....**atripes** McAtee
3. Tibiae largely reddish; median area and preapex of wings clouded; third antennal joint reddish (19–24 mm).....(94) **rubidum**
Tibiae black; wings uniformly very pale brownish; third antennal joint black (15–18 mm).....(95) **fulvicauda**

Ommatius Wiedemann

1. Black species, grayish pollinose, coxae black, scutellum with weak white hairs and no marginal bristles, legs yellowish, the femora above and anteriorly (posterior femora posteriorly also) brownish, as are tips of tibiae and tarsal segments; costa of wings of male dilated (13–17 mm).....(96) **tibialis**

Mallophora Macquart

1. Very large black, robust species (25–35 mm); abdomen metallic blue-black, black-haired; scutellum yellow-haired; wings black with violet reflections.....(100) **belzebul**
Smaller species.....2
2. Disk of thorax grayish pollinose, small species.....4
Disk of thorax black pollinose, large species.....7
4. Posterior tibiae black-haired on whole length dorsally.....5
Posterior tibiae white-haired on basal half.....6
5. Femora broadly reddish basally (9.5–11 mm).....(97) **acra**
Femora black basally (6–9 mm).....**laphroides** Wiedemann
6. Femora broadly reddish basally (9–12 mm).....(101) **guildiana**
Femora black basally (10–14 mm).....**clausicella** Macquart
7. Black species; scutellum, abdominal segments 1–4 above, pronotum, anterior fringe on mesonotum, head, yellow-haired; venter of abdomen and tip black-haired (16–24 mm).....(99) **orcina**
8. Brownish black species; abdomen, including venter, all yellow-haired as is scutellum, fringe from base of wings to C3, anterior part of thorax and head, propleura all yellow-haired; legs reddish brown (15–18 mm).....(98) **bromleyi**

Promachina new genus

1. Black species, yellowish pilose; thorax grayish yellow pollinose with usual black markings; beard white, mystax yellow, wings pale brownish, legs black, tibia reddish except apices, scutellum with a few black bristles and yellowish hairs (15–20 mm).....(103) **trapezoidalis**

Promachus Loew (after Hine)

1. Male genitalia with dense silvery hair above.....4
Male genitalia without dense silvery hair above.....2
2. Abdomen with long thick whitish pile on first three tergites, black, brown wings (28–35 mm).....(104) **painteri**
Abdomen otherwise.....3

3. Light bands on abdomen fully as wide as black bands; legs reddish; thorax reddish brown, male genitalia with black hair (28–36 mm) ..... (112) **hinei**
Light bands on abdomen confined to narrow posterior borders of segments 4
4. Gray shadow in first submarginal cell less than half as wide as cell; male genitalia rounded at apex; mystax black and yellow; femora, apex of tibiae and tarsi black, remainder of tibiae yellowish red (22–27 mm) ..... **sackeni** Hine
Gray shadow in first submarginal cell darker in color than usual, more than half as wide as cell; male genitalia truncate at apex (23–30 mm) ..... **forfex** Osten Sacken
5. First submarginal cell with a gray shadow 6
First submarginal cell without gray shadow 10
6. Abdomen without black hair on any of segments above; head, mystax, and hair of abdomen yellowish 7
Abdomen with black hair on some or all of first five segments 8
7. Gray shadow in first submarginal cell wider than marginal cell, male genitalia almost as long as segments 5, 6, and 7 (20–30 mm) ..... (107) **fitchii**
Gray shadow in first submarginal cell distinctly narrower than marginal cell; male genitalia shorter than segments six and seven (22–32 mm) ..... (108) **texanus**
8. Mystax yellowish; legs reddish or yellowish 9
Mystax white; legs black; abdomen densely brown pollinose on sides (22–28 mm) ..... (105) **albifacies**
9. Abdomen densely brown pollinose on venter and sides; wings plainly brownish; palpi with black hair (21–34 mm) ..... (106) **bastardi**
Abdomen pale yellowish gray pollinose on venter and sides; wings lighter brownish, nearly hyaline (22–32 mm) ..... (108) **texanus**
10. Thorax reddish brown pollinose; legs reddish brown; abdomen black with posterior margins of segments with fringe of white hairs; beard and mystax white (27–35 mm) ..... (109) **magnus**
Thorax whitish pollinose; abdomen banded black and white 11
11. Very large species (35–47 mm); wings exceptionally long; mystax and beard white; abdomen alternately banded black and white ..... (111) **giganteus**
Small species (24–26 mm); legs dark reddish; tarsi nearly black; abdomen dull black; venter, sides, and posterior part of dorsum of each segment with white hairs ..... (110) **minusculus**

Proctacanthus Macquart (after Hine)

1. Reddish species 2
Grayish or brownish pollinose species 3
2. Thoracic dorsum uniformly reddish, male genitalia from above wider than preceding abdominal segments, appendages longer than seventh and eighth segments combined (30–40 mm) ..... (118) **hinei**
Thoracic dorsum blackish; or brownish with darker vittae; male genitalia from above not wider than preceding abdominal segments, appendages shorter than seventh and eighth segments combined (27–40 mm) ..... (119) **rufus**
3. Wings hyaline or with only the veins margined with brown 4
Wings of a uniform brown all over 7
4. Scutellum with white bristles; all bristles of beard nearly white; legs light colored, femora darker before than behind, all parts of legs with black bristles and pale hairs (26–28 mm) ..... **duryi** Hine
Scutellum with black bristles 5
5. Wings clear hyaline, all femora black (23–30 mm) ..... (115) **nigrifemoratus**
Wings with veins margined with brown; posterior sides or more of femora red 6
6. Male genitalia elongate, the appendages curved inward at tips and enclosing an open space beyond the other parts; mystax and beard white, the former with a few black bristles; palpi with black and white hairs (28–36 mm) ..... (113) **arao**
Male genitalia short, appendages but slightly longer than other parts; mystax pale yellow, beard white; wings hyaline with brown margins to veins (26–36 mm) ..... **micans** Schiner
7. Palpi with white hair, thorax with brown markings, wings clear brown, wide and long; two or three bristles on front side of F3 besides those near apex; body grayish pollinose; mystax yellow; proboscis slender (32–39 mm) ..... (116) **longus**
Palpi mostly black-haired; thorax with dark, nearly black markings, wings pale brown; proboscis thickened at base 8
8. Large stout grayish pollinose species; mid-dorsal stripe of thorax gray pollinose and not plainly differentiated; mystax pale yellow; wings uniformly light brown; male genitalia shorter than last two abdominal segments combined; appendages not curved, (28–40 mm) ..... (117) **milbertii**
Smaller species, mid-dorsal thoracic stripe usually plainly differentiated and not distinctly pollinose; legs brown, femora darkest (black before and brown behind) (20–28 mm) ..... (114) **brevipennis**

Eccritosia Schiner

1. Deep brown species, bristles black, legs brownish red, hind tibiae yellow, mystax pale yellow; abdomen beyond second segment orange yellow with tufts of yellow hairs, base black with black hairs, wings light brown; beard variable, yellowish or blackish (19–29 mm) ..... (120) **amphinome**

Erax Scopoli (after Hine)

1. Furcation of the third vein distinctly before the base of the second posterior cell making the second submarginal cell long 2
Furcation of third vein opposite or beyond base of second posterior cell 20
2. Three submarginal cells (**anomalus** group) 3
Two submarginal cells 5
3. Bristles of palpi, scutellum, and upper occiput black (18–26 mm) ..... (121) **anomalus**
Bristles of palpi (usually scutellum), mystax, and upper occiput pale 4
4. Male abdomen with white hairs parted at middle and directed outward (15–30 mm) ..... (122) **candidus**
Male abdomen gray pollinose and without hairs parted at middle and directed outward (15–20 mm) ..... **pernicis** Coquillett

5. Rear of thorax and scutellum with abundance of bristles, male abdominal segments of six and seven silvery, female with tip of oviduct furcate from above (**rufibarbis** group)..... 6
Male abdomen usually with several segments silvery, female with tip of oviduct never divided from above. Male, except in a very few cases, with one or more abdominal segments bearing long white hair parted at middle and directed outward (**stramineus** group)..... 7
6. Mystax yellow, body and wings dark colored (16–30 mm)..... (123) **rufibarbis**
Mystax white, body gray pollinose, wings hyaline (24 mm)..... (124) **bicaudatus**
7. Furcation of third vein at or before middle of distance between the base of the second posterior cell and the small cross vein..... 8
Furcation of third vein distinctly beyond the middle of the distance between the base of the second posterior cell and the small cross vein..... 16
8. Male abdomen without long hair parted at middle and directed outward on one or more segments.. 9
Male abdomen with long hair parted at middle and directed outward on one or more segments.....10
9. Male genitalia from side view plainly divided at tip, oviduct conical, abdomen with interrupted gray pollinose bands, scutellum with black bristles; light brownish pollinose species (22–30 mm), (125) **interruptus**
Male genitalia from side view not divided, narrowest at apex, tibiae basally reddish yellow (23–30 mm)..... (127) **texanus**
Yellowish pollinose species, the abdomen silvery pollinose; male genitalia from side view tapering to a point (18–25 mm)..... (126) **bexarensis**
10. Mystax yellow.....11
Mystax not yellow.....12
11. Tibiae at least largely red, male third abdominal segment only with long white hair parted at middle and directed outward (22 mm)..... (128) **aurivestitus**
Legs black, body yellowish gray pollinose, male with abdominal segments three to seven inclusive white haired (20–25 mm)..... **rapax** Osten Sacken
12. Mystax composed of black and white bristles and hairs intermixed, hypopygium not widened, apices of femora red following black (17 mm)..... **eximeus** Bellardi
Mystax wholly pale.....13
13. Hypopygium plainly notched on apical border.....14
Hypopygium not notched on apical border.....15
14. Thorax yellowish pollinose, first two segments of male abdomen like thorax, legs black, extreme bases of tibiae reddish yellow (18–23 mm)..... (129) **argentifrons**
Thorax gray pollinose, first two segments of male abdomen like following ones (23–25 mm), (130) **argyrosoma**
15. Hypopygium truncate at apex; yellowish brown; abdomen gray (22–30 mm)..... **truncatus** Hine
Hypopygium rounded at apex, short; yellowish gray pollinose species (18–23 mm)..... **pallidulus** Hine
16. Femora largely red, especially posteriorly; male abdominal segments two to six inclusive with black markings (23–25 mm)..... **triton** Osten Sacken
Femora all black.....17
17. Mystax white, scutellum with long white hair and bristles; very small species (12 mm), mesothorax posteriorly white haired..... (131) **pilosus**
Mystax yellow, scutellum with yellow or black hair and bristles.....18
18. Mystax bright yellow, scutellum with long yellow hair and bristles (16–24 mm)..... (132) **auripilus**
Mystax pale yellow, scutellum with black hair and bristles.....19
19. Male, first three abdominal segments without silvery markings, female uniformly yellow pollinose, robust species (23–32 mm)..... (133) **plenus**
Male, only first two abdominal segments without silvery markings; female, abdomen with a series of large black markings dorsally, one to each segment (24–30 mm)..... (135) **nemoralis**
Male, only seventh segment silvery, no long silvery hairs on abdomen (21–26 mm); less robust than either of preceding..... (134) **prairiensis**
20. Posterior branch of third vein curved backward at tip, meeting the costa at or beyond apex of wing (**aestuans** group).....21
Posterior branch of third vein curved forward meeting the costa plainly before the apex of the wing..25
21. Legs black, hypopygium black shining, tumid, narrowed before apex, produced into a tubercle (12 mm)..... (140) **mexicanus**
Tibiae partly reddish or yellowish, hypopygium from side view, most prominent apically on upper half, small species (10 mm), mystax black with gray hairs intermixed, costal border not dilated in male, gray pollinose species with black markings resembling **aestuans** in appearance, (136) **belfragei**
Tibiae partly at least, reddish, yellowish, or brownish; hypopygium most prominent at middle apically, larger species.....22
22. Costa more or less dilated in male; usually larger, robust species; mystax black, intermixed with white hairs; tibiae brownish.....23
Costa not dilated, smaller, slenderer species; mystax with black bristles above and pale yellow hairs below; tibiae honey-yellow in part.....24
23. Large species (26–32 mm), robust..... **femoratus** Macquart
Smaller species (14–28 mm), less robust; tibiae brown, general body color black with contrasting gray pollinose bands and spots..... (137) **aestuans**
24. Apical part of hypopygium narrowed and curved downward, with a tooth-like prominence above, (12–22 mm)..... (138) **apicalis**
Apical part of hypopygium nearly as wide as preceding part; mystax largely straw-yellow (17 mm), (139) **kansensis**
25. Mesothorax compressed anteriorly and with a conspicuous crest of erect hairs on mid-dorsal line, (**carinatus** group).....26
Mesothorax broadly rounded above and without a conspicuous crest of hairs.....27
26. Vestiture of scutellum, aside from black marginal bristles, white; femora all black; slender species, male costa only slightly thickened, male abdomen with at least four or five segments silvery and with long, white hair parted at middle and directed outward; hypopygium divided apically with both parts of nearly equal length (14 mm)..... (141) **cressoni**
27. Mesothorax with numerous bristly hairs, which are unusually long, scutellum conspicuously hairy and with numerous marginal bristles (**aridus** group).....28
Mesothorax with very short hair anteriorly, a few rather prominent bristles posteriorly; scutellum with short hair on disk and usually with not more than half a dozen bristles on margin.....29

28. Mystax straw yellow; male abdominal segments four to seven silvery; four more or less black on mid-dorsal line, brownish species (22 mm).....(142) **snowii**
Mystax white; hypopygium from dorsal view plainly widened towards apex where it is distinctly wider than at base (16 mm).....(143) **pratti**
29. Male with ventral prominences on abdominal segments four, five, and six; small slender species, (**tuberculatus** group).....31
Male abdomen without ventral prominences, usually medium sized or large robust species (**barbatus** group).....32
31. Hypopygium and ventral tooth-like processes black, the latter acute at apex, gray pollinose species (15–17 mm).....(144) **tuberculatus**
32. Hypopygium small or of normal size, medium-sized or small species, usually of slender build, male costa not at all or only very slightly expanded, female with each abdominal segment black, with posterior gray border of various widths according to species.....33
Hypopygium distinctly enlarged, large to very large species, male costa rather conspicuously thickened and expanded, female abdomen variously marked, but usually the segments not black with posterior gray borders, although this is the case in at least two species.....35
Hypopygium distinctly enlarged, costa not at all thickened and expanded, mystax straw yellow in both sexes, bristles of thorax and scutellum pale; abdomen, uniformly yellowish gray pollinose; male with apical abdominal segments partly or wholly silvery (25–30 mm).....(145) **leucocomus**
33. Gray bands of abdomen regular and wide approaching width of black intervals, hypopygium red with prominent array of ventral hairs, most conspicuous basally (16 mm).....**zonatus** Hine
Hypopygium blackish, gray abdominal bands irregular or very narrow.....34
34. Mystax pale, sometimes with a few black bristles on upper margin (13–20 mm).....(146) **barbatus**
Mystax largely black with pale hairs and bristles intermixed; five, six, and seven segments of male abdomen silvery; pale bands of abdomen silvery, regular and narrow (22 mm)...**willistoni** Hine
35. Male hind tibiae with an abnormal enlargement on apical half (30–32 mm).....(147) **armatus**
Male hind tibiae with apical third enlarged (28–30 mm).....(148) **tagax**
Male hind tibiae normal; male seventh abdominal segment entirely silvery dorsally; female fifth abdominal segment not silvery.....36
36. Wings hyaline; grayish pollinose species (21–26 mm).....(149) **bicolor**
Wings brownish, especially towards apex; disk of scutellum with black instead of white hair, (31–35 mm).....(150) **grandis**

Asilus Linnaeus (after Hine)

1. A transverse row of bristles clearly larger than the hairs on the sides of abdominal segments; wings pale or hyaline.....3
This row of bristles wanting; wings distinctly colored.....2
2. Body and legs uniformly black, wings uniformly rich yellowish brown (30–35 mm).....**midas** Brauer
Body brown, legs pale brown, wings brownish with veins margined with paler brown; body light yellowish brown pollinose (20–28 mm).....(151) **sericeus**
3. Arista of antennae about twice as long as third antennal segment; yellowish; mystax yellowish, legs almost entirely pale reddish or yellowish (15–17 mm).....(152) **gracilis**
Brownish; legs brown; mystax white (17 mm).....(153) **compositus**
4. Arista at most only a little longer than third antennal segment; legs usually partly black.....5
5. Very small species (8–12 mm), pale yellow pollinose, bristles of body and legs light colored; genitalia red; antennae with very short arista, hardly differentiated from third segment...**mesae** Tucker
Larger species; arista plainly differentiated from third segment.....6
6. Arista about as long as third antennal segment; only two bristles in addition to apical bristles on front side of hind tibiae.....7
Arista not over two-thirds as long as third segment; three bristles on front side of hind tibiae; yellowish or brownish pollinose species.....8
7. Black species; tibiae reddish on basal third (14–18 mm).....(154) **notatus**
Reddish species; mystax straw yellow, legs reddish, male genitalia red, small species (12–15 mm), (155) **rubicundus**
8. Small reddish species, legs red, at most only anterior side of each femur slightly darkened, male genitalia red (12–15 mm).....(155) **rubicundus**
Femora in large part black.....9
9. Each femur with the preapical band and posterior side red, mid-dorsal thoracic stripe not very distinct and abbreviated behind; male genitalia black or dark fuscus; under side of F1 with longitudinal row of bristles (14–20 mm).....(156) **prairiensis**
Each femur with only a preapical red band; underside of front femur with row of bristles; upper forceps of male genitalia, from side view, of same width throughout (13–17 mm).....(157) **paropus**

Proctacanthella new genus

1. Upper forceps of male genitalia protruding half their length beyond lower forceps; light gray pollinose species (15–18 mm).....(158) **leucopogon**
Upper forceps of male genitalia about equal in length to lower part, which is terminated by a distinct pencil of long white hairs; pale grayish brown pollinose species (15–18 mm)....(159) **cacopiloga**

Philonicus Loew

1. Legs in large part reddish.....2
At least the femora of all legs black.....5
2. Wings smoky, legs dark red, abdomen black banded with gray (16–19 mm).....**arizonensis** Williston
Slenderer species, wings hyaline or reddish, abdomen gray-black banded with gray.....3
3. Wings limpid, legs pale reddish, brown or fuscous in places (17 mm).....(160) **limpidipennis**
Wings reddish, legs pale reddish but usually black in places.....4
4. Legs rather slender, anterior side of each femur in large part black, upper forceps of male genitalia with the angle at the beginning of the excavation produced inward and backward so that it meets and crosses its fellow of the opposite side (12–14 mm).....(161) **truquii**
Legs rather thick, each femur black except at tip of anterior side, angle of forceps not produced (15 mm).....**rufipennis** Hine
5. Legs, except extreme bases of tibiae, black (11–15 mm).....**tuxpanganus** Bellardi
Tibiae and tarsi in large part reddish (10–16 mm).....**fuscatus** Hine

DESCRIPTIONS OF NEW SPECIES

(7) **Leptogaster texanus** n. sp.

Total length, 10–13 mm. A pale reddish brown species with white pollinose pleura and with abdomen and femora more or less lightly ringed with pale brown.

Male.—Face white pollinose, occiput brownish pollinose. Proboscis and epistoma reddish. Palpi blackish. Mystax pale yellow. Occipital bristles brown. Antennae pale reddish, arista black. Thorax reddish brown, the pleura white pollinose, the mesonotum with a light brownish median line and a spot of similar color on each side. Scutellum brownish pollinose. Wings pale smoky, halteres brownish, the knob nearly black. Thoracic bristles and ungues black. Leg bristles yellowish. Legs yellowish, the tarsi and tips of Tb_1 and Tb_2 reddish, Tb_3 slightly thickened apically, the apical half reddish. F_1 and F_2 partially ringed with pale brown toward apex, F_3 with basal two-thirds reddish brown followed by a pale yellow band, then the widest portion ringed with brown. Abdomen pale reddish brown, each segment more or less ringed with brown.

Female.—Similar.

Holotype, male. College Station, May 18, 1926 (H. J. R.). *Allotype*, female. College Station, May 22, 1924 (H. J. R.). *Paratopotypes*, seven females, April 24-June 23; one male, May 11, 1928 (all H. J. R.), one female, Bexar Co., Sept. 30, 1930 (H. B. P.). *Paratypes*, Austin, May 19 and June 10, 1921 (R. H. P.).

Related to *eudicranus* Loew, but the ground color of the entire body as well as the abdomen is pale reddish brown instead of brownish black. The abdomen is also ringed and the dark markings on the legs are brownish and not blackish. The third antennal segment is entirely reddish, not black on the distal portion, although the arista is black.

(11) **Ablautus mcgregori** n. sp.

Total length, 7 mm. A small reddish species, silvery pollinose and pruinose, the lower portions of the pleura polished black, legs brownish, femora pale reddish, abdomen silvery pollinose, punctate, the second, third, and fourth segments with large blackish spots separated dorsally, fifth segment reddish.

Male.—Antennae dark reddish, style small, pointed, blackish. Head with exception of a bare spot above mystax, silvery pruinose. Vestiture white. Proboscis piceous. Thorax reddish, silvery pollinose, pruinose and pilose. Mesonotum with brownish maculations, lower portion of pleura polished black. Coxae polished piceous, C_1 and C_3 with a silver pruinose patch, scutellum yellowish, silvery pollinose, with a few white, weak marginal bristles on each side. Halteres pale yellowish; wings hyaline with yellowish veins. Tarsi, tibiae, and tips of femora reddish brown, rest of femora pale reddish, thickly covered with appressed silvery pile. Claws black; empodia whitish. Some of tarsal bristles black. Abdomen reddish, silvery pollinose, punctate, first segment largely blackish, two to four with black spots separated dorsally, fifth segment dark reddish, genitalia dark reddish, concealed from above by fifth segment.

Holotype, male, Uvalde Co., Sept. 12, 1932 (S. E. McG.).

Differs from *rufotibialis* Back in being mostly reddish in ground color, and in having reddish femora instead of black. I am naming this species in honor of its collector, Mr. S. E. McGregor, whose interest in this family of Diptera and active collecting have brought to hand many interesting species for the present study.

(16) **Ospriocerus parksi** n. sp.

Total length, 14–15 mm. A black species with orange scutellum and mesonotum, the latter with a black median spot narrowed anteriorly and extending to the pronotum. Wings with bluish lustre.

Male.—Deep black. Sides of face and occiput silvery pruinose. Rest of head and vestiture black. Rest of body, halteres, legs and vestiture black, except mesonotum and scutellum which are orange; the mesonotum with an irregular central black spot, produced anteriorly, narrowly, to the pronotum, widening slightly at the margin. Wings deep black with bluish lustre.

Female.—Similar.

Holotype, male. Bexar Co., May 1, 1932. *Allotopotype*, female, May 6, 1931, and *paratopotype*, female, May 29, 1932. All collected by H. B. Parks, in whose honor the species is named. *Paratype*, Bexar Co., May 1, 1929 (H. B. Parks) (J. Wilcox).

Differs from *minos* O. S. in having the mesonotum with a large black median spot extending in a narrow line to the pronotum, but with the remainder of the mesonotum orange. The scutellum also is orange.

(35) **Holcocephala bullata** n. sp.

Total length, 5–7 mm. A robust species, with broad, flattened abdomen. Very dark brown, nearly black species with blackish wings, the tips paler. Vestiture light golden brown.

Male.—Head black, face dark gray pollinose, vestiture pale golden brown, antennal style spine-like, pointed at tip directed forward and slightly downward, and about three-fourths the length of the third segment. Thorax dark brown pollinose, scutellum slightly lighter. Halteres pale brown. Wings brown, basal half opaque. Legs and abdomen brown, vestiture pale golden brown. Genital forceps from above slender, widely separate.

Female.—Similar, ovipositor with pale hairs.

Holotype, male, Bexar Co., June 7, 1928. *Allotopotype*, female, May 23, 1931. *Paratopotypes*, two males, eight females, May 15–June 7. (All collected by H. B. Parks.) *Paratypes*, eleven males and females, Howe, June 13, '33 (S. E. McG.).

Quite distinct from *calva* Loew in both habitus and coloration.

(36) **Holopogon texanus** n. sp.

Total length, 5–7 mm. A black species, stouter than *phaeonotus*, with thorax and head light brownish pollinose, the abdomen shining black, the wings fumose, darker toward the base, and the legs with shining black femora, and reddish tibiae and tarsi.

Male.—Head black, mystax and beard white. Face, vertex, and occiput golden brown pollinose. Thorax black, mesonotum and scutellum pale brown pollinose, the mesonotum with a black median stripe and side spots. The pleura white pollinose. Femora shining black, tibiae and tarsi red, the latter darker. The apex of the hind tibia black. Legs with fine white hairs and black bristles. Wings fumose, darker basally. Halteres yellow. Abdomen shining black.

Female.—Similar.

Holotype. Male, Bradley, July 25, 1921 (R. H. P.). *Allotype.* Female, same data. *Paratypes.* Males and females. Bradley, Brownwood, May, and Junction. July 21–August 30. (All R. H. P.). "On tip of dead broomweed." "Resting on dead twig of sumac." The Junction specimen "on tip of dead button willow." (Painter). McLennan Co., June 19, 1933 (H. B. Mills).

This species differs from *snowii* Back in having fumose wings instead of hyaline; and from *lautus* Coquillett in having the tibiae and tarsi red. *Lautus* presumably has the legs entirely black, although Coquillett did not mention the color of the legs specifically in his description other than the blanket diagnosis of the species as "black."

(48) **Stichopogon colei** n. sp.

Total length, 8–11 mm. A silvery white pollinose species related to *S. abdominalis* from which it may be distinguished by the silvery pollinose abdomen, each tergite of which bears a large triangular blackish gemma. The males and to a less extent the females have the dorsal median areas of the tergites finely golden brown pollinose.

Male.—Proboscis, palpi, and antennae black; vestiture scanty, white. Face, vertex, occiput, and antennae white pollinose. Thorax and legs white pollinose. Hairs and bristles scanty, white. Legs black, bases of tibiae reddish. Mesonotum with an indistinct, broad dark anterior spot, and a slight amount of scattered brownish bloom. Wings hyaline; costa, subcosta, and R_1 yellowish. Scutellum white pollinose, bare. Halteres pale yellow. Abdomen white pollinose, with a fine golden brown bloom above. Tergites one to seven with a triangular black spot.

Female.—Similar, more golden brown on thorax than in male, abdomen less so. A spot above humeri and a line above wings golden brown pollinose.

Holotype, male, Rio Grande, Brewster Co., May 9, 1927 (J. O. Martin). *Allotype*, female, same data. *Paratypes*, two females, same data; two females, Milano, Aug. 30, 1933 (S. E. McG.).

This species was sent to the writer by Dr. F. R. Cole, after whom the species is named. The types are deposited in the collection of the California Academy of Sciences. The paratypes are placed, one in the collection of the writer and 3 in the collection of the Texas Experiment Station. The following paratypes were sent by Mr. Wilcox: four specimens from Bexar Co., Sept. 17, 1931; Oct. 20, 1932; Sept. 29, 1931; and Sept. 29, 1932, collected by H. B. Parks.

(52) **Saropogon pritchardi** n. sp.

Total length, 20–23 mm. Related to *dispar* but slightly smaller, more slender, the wings proportionately longer and broader, the legs uniformly reddish without dark markings. The wings are black, the abdomen black with light lateral pollinose spots, the thorax yellowish pollinose, the scutellum with two pale bristles.

Male.—Head yellowish gray pollinose. Antennae reddish brown. Palpi and proboscis black. Palpal hairs straw-colored. Mystax, beard, and occipital bristles pale yellowish. Thorax yellowish brown pollinose with light yellowish brown bristles. Legs uniformly reddish with concolorous hairs and bristles. Wings black, long, and broad. Halteres reddish. Abdomen black, the posterior lateral margins of segments one to five with grayish pollinose markings.

Female.—Similar.

Holotype. Male, Mills Co., Texas, July 20, 1931 (R. H. P.). *Allotype.* Female, Randlett, Okla., July 15, 1931 (R. H. P.). *Paratypes.* Female, Randlett, Okla., July 15, 1931 (R. H. P.). Female, Harper Co., Okla., Aug. 23, 1932 (A. E. Pritchard). Female, No. 20 (no other data) (A. E. Pritchard).

I am naming this *Saropogon* in honor of Mr. A. E. Pritchard who first brought the species to my attention.

(53) **Saropogon fletcheri** n. sp.

Total length, 24–27 mm. A large pale reddish species with legs entirely red, scutellum with four reddish bristles, wings pale reddish brown. The anterior margins of abdominal segments two to five are narrowly black.

Male.—Head reddish except proboscis which is black with basal under portion reddish. Mystax straw-colored. Occipital and ocellar bristles pale reddish. Thorax reddish, golden or reddish pollinose, the coxae and pleura brownish in ground color. Mesothorax with a brownish divided median stripe and side spots. Bristles reddish. Legs uniformly reddish with concolorous hairs and bristles. Claws black. Wings pale reddish brown. Halteres reddish. Abdomen red with concolorous hairs. Anterior margins of segments two to five narrowly black.

Female.—Similar, wings paler.

Holotype, male, July 19, 1921. *Allotopotype*, female, same data. Both collected by Dr. R. K. Fletcher in whose honor the species is named. *Paratypes*, Austin, May 21–July 17 (17 specimens); Ozona, Aug. 28, 1924 and Brownwood, Aug. 21, 1931 (one each) (R. H. Painter).

Related to *S. dispar* but is reddish in both sexes and the femora have no black whatsoever.

(58) **Diogmites texanus** n. sp.

Total length, 18–23 mm. A reddish species with three velvety black stripes on the mesonotum, the wings blackish or dark brownish, prothoracic bristles dark reddish, abdomen flattened and rather short, not coarctate, abdominal segments with blackish areas along the sides which may in some individuals extend across the dorsum of some of the segments.

Male.—Head reddish, antennae with style and tip of third segment black. Upper and distal portion of proboscis black. Vertex and occiput golden brown pollinose; pollinosity of face, beard, and mystax straw-colored. Ocellar bristles black. Occipital bristles and palpal hairs reddish. Thorax light golden brown pollinose, mesonotum with three velvety-black lines, the median extending practically to the pronotum. Bristles black; hair of coxae straw-colored. Scutellum with two black bristles. Legs reddish brown with black bristles and very fine black hairs. Hypopleura with a tuft of reddish hairs. Knob of halteres lemon-yellow. Wings blackish or very dark brown. Abdomen pale reddish pollinose, the genitalia reddish with black and reddish hairs intermingled. There is an oblique black spot on the sides of each segment which may be produced into bands over the dorsum of some of the segments. In the type this is the case.

Female.—Similar, wings lighter brown and halteres brownish. Bristles of ovipositor black.

Holotype, male, Madison Co., (along Trinity river), Aug. 4, 1932. *Allotopotype*, female, July 24, 1932 (both collected by S. W. Bromley). *Paratopotypes:* 6 males, 5 females, June 28–Aug. 10. Collected by Bromley, Bibby, and O'Dowd. *Paratype*, Liberty Co., Sept. '33 (S. E. McG).

(64) **Nicocles reinhardi** n. sp.

Total length, 9 mm. A brownish species, with wings clouded with brown, abdomen with first five segments polished black, reddish legs, antennal style one-half as long as third segment.

Female.—Antennae, proboscis, and palpi black. Mystax, ocellar, and occipital bristles pale reddish. Face brown pollinose, occiput gray pollinose. Thorax brownish pollinose, the pleura and postscutellum lighter, particularly the latter which is more grayish. Scutellum with two weak marginal bristles. Halteres yellow. Wings very pale brown, the veins beyond the middle with margins clouded with brown which, in the marginal cell, covers all but a small pale median area.

Legs reddish, coxae black (gray pollinose), the femora ringed with black toward the apex. Tips of tibiae and tarsal segments blackish. Vestiture of legs straw-colored. The middle tibia with a subapical spine. Abdomen finely grayish pollinose, the venter and lateral anterior portions decidedly so; the first five segments above polished black extending to a posterior point on the sides, remainder reddish with the sides grayish pollinose. Ovipositor with black spines.

Holotype, female, College Station, Nov. 1, 1927 (H. J. R.). The species is named in honor of the collector, whose untiring efforts for seventeen years in this state have greatly increased the knowledge of Texas insects. *Paratypes*, Bexar Co., Sept. 21, 1931 (H. B. P.) (J. Wilcox).

The brown area of the wing does not encompass the first and second posterior cells as in *aemulator* Loew. It may be distinguished from *argentatus* Coquillett and *politus* Say by the color of the legs and by the coloration of the mesonotum which is uniformly brownish pollinose, not black, and the maculations are very indistinct.

(66) **Cophura texana** n. sp.

Total length, 8–10 mm. A blackish species, rather slender, with basal half of tibiae reddish, the middle tibiae with a strong apical spur on the underside. The thorax does not have a crest of hairs, the abdominal segments are brownish pollinose anteriorly and gray pollinose laterally, the pollen not enclosing a black spot, and the anal cell narrowly open.

Male.—Antennae, proboscis and palpi blackish. Vestiture scanty, white. Face and occiput silvery pollinose. Antennal style slender, sharp pointed about one-fourth the length of the third segment. Thorax black, mesonotum brownish pollinose. Scutellum, pleura and posterior lateral portions of mesonotum silver pollinose. Halteres pale reddish; wings hyaline with very faint brown clouding beyond the middle. Bristles of thorax scanty, pale. Scutellum with two weak pale marginal bristles. Legs black with whitish hairs, basal half of tibiae reddish, pulvilli light grayish, abdomen polished black with pale weak vestiture, anterior portions of segments brown pollinose, lateral portions and venter grayish white pollinose. Genitalia black with white hairs.

Female.—Similar.

Holotype, male, Comfort, July 21, 1921. *Allotopotype*, female, same data. Both collected by R. K. Fletcher.

Differs from *C. trunca* Coquillett (California) in having only the basal half of the tibiae reddish yellow, the rest of the legs black and the mesonotum brownish pollinose instead of gray.

(70) **Psilocurus puellus** n. sp.

Total length, 7–9 mm. A small blackish species with the scutellum bearing two bristles in the male, four in the female, the antennae wholly black and the legs black, the bases of the tibiae and the under parts of femora red.

Male.—Head black. Antennae, proboscis and ocellar bristles black. Rest of vestiture of head white. Face, vertex, and occiput silvery pruinose. Thorax black, pleura silvery pruinose and pollinose, dorsum with fine yellowish short hairs. Legs black, undersides of femora red. Wings hyaline. Halteres yellow. Abdomen slender shining black, posterior lateral margins of segments one to six with small white pruinose spot.

Female.—Similar, but the pruinosity is yellowish, not silvery.

Holotype, male, Bexar Co., May 9, 1931 (H. B. Parks). *Allotype*, female, Spur, Sept. 12, 1932 (Bromley and O'Dowd) (in S. W. Bromley

collection). *Paratypes*, Brownwood, June 7 (seven specimens) (R. H. Painter); Bosque Co., June 18, '33 (H. B. Mills).

Smaller and slenderer than *P. birdi* Curran.

(90) **Bombomima nigella** n. sp.

Total length, 19 mm. Described from one male. Black, black haired, the following portions with yellowish hairs: the mesonotum, the posterior lateral portions of abdominal tergite number two and the complete dorsal areas of segments three and four.

Male.—Head black, vestiture wholly black. Thorax black with black vestiture, including pronotum and scutellum. Disk of mesonotum with brownish yellow pile. Legs black with black vestiture; undersides of tibiae reddish brown to piceous, the anterior tarsi reddish brown pruinose below. Wings and halteres dark brown. Abdomen black; black pilose for the most part, but with dorsal areas of segments three and four and the lateral portions (posterior) of number two, yellow pilose. Genitalia piceous, black haired.

Holotype, male, Austin, May 21, 1921 (R. H. Painter) (in Painter's collection).

Related to *macquartii*, but there is no yellow pile on the legs, and the distribution of yellow pile on the abdomen is different. In *macquartii*, the first abdominal segments are yellow haired above.

(104) **Promachus painteri** n. sp.

Total length, 28–35 mm. A rather large, comparatively slender black species, with brown wings (a definite shadow in the first submarginal cell), dark brown pollinose, with black hairs, except the first three abdominal tergites which bear long, pale, thickly-set yellowish white pile. The beard is yellowish white and the mystax mixed black and white.

Male.—Head black; face pale yellowish brown pollinose. Antennae, palpi, palpal hairs, bristles and hairs of occiput and vertex black. Beard thick pale yellowish white. Mystax composed of both black and whitish bristles. There are some pale hairs on the lower portion of the occiput which is yellowish pollinose.

Thorax black, brown pollinose, with black hairs. Some of the acrostichal bristles are light. Scutellum with both black and white bristles intermingled. Legs black or deep piceous with black vestiture. Wings uniformly brown, with a definite shadow in the first submarginal cell.

Abdomen black with black hairs, except the first three tergites which are thickly set with long pale, yellowish white pile. Posterior margins of most of anterior (to five or six) segments with pale brown pollen. Genitalia black, black haired, narrow, about as long as the seventh segment.

Female.—Similar. Ovipositor black, differentiation beginning with the sixth segment.

Holotype, male, Austin, May 24, 1922 (R. H. P.). *Allotype*, female, Austin, July 21, 1924 (R. H. P.). *Paratopotypes*, males and females, July 21–Oct. 14 (R. H. P. and F. J. Hull). *Paratype*, female, Ozona, Aug. 24, 1928 (R. H. P.).

Entirely unlike any other species hitherto recorded from the United States. It is somewhat suggestive of *Promachina trichonota* Wied., a South American species belonging to the *Promachina* group, which have blunt claws as in the genus *Mallophora*.

I take pleasure in naming this unique species in honor of Prof. R. H. Painter, who has collected so extensively and amassed so many notes of interest regarding the Asilidae of Texas.

(108) **Promachus texanus** n. sp.

Total length, 22–32 mm. A yellowish brown pilose and pollinose species, the hypopygium silver-haired, not as long as segments six and seven; the legs reddish brown, femora darker above.

Male.—Proboscis and antennae dark brown, yellowish pollinose, all vestiture thick, yellowish, a few black bristles on occiput. Thorax yellowish brown pollinose, the mesonotum with darker markings, pale yellowish, bristles black. Scutellum with yellow pile and black bristles. Wings very pale brown. Halteres black. Legs pale reddish brown, femora darker above, the hairs yellow, the scattered bristles black. Abdomen black, yellow pilose. Posterior and lateral portions of segments yellow pollinose. Third segment usually with short black hairs anteriorly and laterally. Hypopygium short, silver haired.

Female.—Similar, ovipositor black.

Holotype, male, College Station, June 11, 1931 (H. J. R.). *Allotopotype*, June 13, 1929. *Paratopotypes*, 45 specimens (both sexes), May 28–June 28. (Tex. Agri. Exp. Sta., and Texas A. & M. College.) *Paratypes*, one female, McLennan Co., June 14, '33 (F. F. B.); 2 specimens, Prairie View, June 18, '33 (H. J. R.).

Related to both *P. bastardi* Macquart and *P. fitchii* O. S.; from the latter it may be distinguished by the much shorter hypopygium, the fact that there are generally a few black hairs on the side of the third abdominal segment, and the gray shadow in the first submarginal cell narrower than the marginal cell; from the former by the yellow pollen and pile of the entire body. This species has been frequently identified as *quadratus* Weidemann, a large form related to *bastardi* Macquart occurring in the Southeastern States, possibly not specifically distinct.

(126) **Erax bexarensis** n. sp.

Total length, 18–25 mm. A yellowish pilose and pollinose species belonging to the *stramineus* group, having the furcation of the third vein slightly before the middle of the distance between the base of the second posterior cell and the small cross vein. The abdomen is silvery pollinose and pruinose, but without long hairs in the male.

Male.—Head pale yellow pruinose and pilose. Thorax yellowish pollinose, all vestiture including bristles and hairs of scutellum yellowish, except the minute hairs on the disk of the mesonotum which are black. Some of the bristles and claws black, rest of vestiture of legs yellowish. Femora, tips of tibiae and tarsi black; tibiae otherwise reddish. Wings nearly hyaline (very pale brownish); veins reddish. Halteres reddish. Abdomen whitish pollinose and finely pruinose. Genitalia reddish brown, slender from above, longer than segments six and seven; from side the upper forceps taper to a point, the base of the lower portion of the genitalia with thick black pile. The first abdominal segment may be slightly yellowish pollinose.

Female.—Similar, ovipositor black, slightly longer than segments six and seven. There may be a few black bristles in occipital region.

Holotype, male, Bexar Co., July 5, 1932. *Allotopotype*, female, July 4, 1932 (H. B. Parks, both). *Paratopotypes*, 1 male, 2 females, June 14–July 5 (H. B. Parks). *Paratypes*, male, Carrizo Springs, June 10, 1928 (W. A. Frazier). Female, Laredo, May 18, 1922. *Paratypes*, Metz, June 6 (6 specimens) (R. H. Painter).

Related to *E. texanus* Banks but distinguished from it by having the thorax light yellow pollinose contrasting with the silvery pollinose abdomen, as well as by the peculiar structure of the genitalia.

(134) **Erax prairiensis** n. sp.

Total length, 21–26 mm. A yellow pollinose species belonging to the *stramineus* group with the furcation of the third vein at or beyond the middle of the distance between the base of the second posterior cell and the small cross vein, the male abdomen without long white hair parted in the middle and with only the seventh segment silvery.

Male.—Head black, straw yellow pollinose and pilose, vertex and occiput with black bristles. Thorax grayish yellow pollinose with black bristles and pale yellow pile. Scutellum with yellow pile and black marginal bristles. Mesonotum with broad median stripe dark brown. Wings pale brown. Halteres pale reddish brown. Legs black, yellow pilose, fine hairs on femora, scattered bristles and ungues black. Tibiae reddish except distal portion which is black. Abdomen yellowish gray pollinose and pilose, seventh segment white pollinose, others with a black anterior dorsal area on which most of the fine hairs are black. Genitalia black with both black and yellow hairs, from above slightly broadened toward the tip.

Female.—Similar, the ovipositor black, slightly longer than segments six and seven.

Holotype, male, June 8, 1932, Prairie View. *Allotopotype*, female, same date. *Paratopotypes*; 2 males, 6 females, same date. All collected on prairie by S. W. Bromley. *Paratopotypes*, 10 specimens, June 18, '33 (H. J. R. and R. K. F.). Flies with a fine high-pitched buzz, alighting on the stalks of grass.

Related to *plenus* Hine, but the male abdomen without long white hairs and only the seventh white. Both sexes are smaller and much slenderer than *plenus*.

Erax canellus n. sp.

Total length, 20–24 mm. A grayish yellow pollinose species of the *stramineus* group, having the furcation of the third vein at or before the middle of the distance between the base of the second posterior cell and the small cross vein. The male abdomen has long, outward directed white pile on the abdomen which is white haired, although rather sparsely, to the base.

Male.—Head, pale yellowish pollinose, vestiture white, the mystax inclined to pale yellowish. Ocellar and occipital bristles black. Thorax gray pollinose, the disk of the mesonotum more yellowish, the median line brownish, bisected longitudinally, with grayish bristles and hairs black, those of pleura white. Scutellum with black hairs and bristles. Wings nearly hyaline, halteres pale brown. Legs with long white hairs and scattered black bristles. Femora black, reddish posteriorly. Tibiae reddish with black tips; tarsi reddish. Abdominal segments black anteriorly, white pollinose posteriorly and on sides, with long white hairs, those on dorsum more or less directed outward. Genitalia piceous, narrow from above, widened toward tip from side, the upper forceps from side nearly truncate at tip with a notch on the border and a spine at the lower apex directed downward and obscured by a patch of black pile.

Female.—Similar. Ovipositor black, slightly longer than segments five, six, and seven.

Holotype, male, Black Dike Prospect, Sierritas, Ariz., July 26–29, 1916. *Allotype*, female, Coyote Mts., Ariz., Aug. 4–7, 1916. *Paratopotypes*, two males, same data as holotype. *Paratypes*, male, near Kits Peak, Baboquivari Mts., Ariz., Aug. 7–9, 1916. Male, Comobabi Mts., Ariz., Aug. 9–10, 1916. (All in American Museum.)

Related to *E. canus* Hine, but the thorax is more yellowish pollinose, the long hairs of the male abdomen are fewer and more sparse and the upper forceps of the male genitalia, from the side view, are notched on the posterior border. The tuft of hair at the inferior apex of the hypopygium is also less conspicuous.

An Arizona species not as yet known from Texas.

DESCRIPTIONS OF NEW GENERA

Promachina n. gen.

Intermediate between *Mallophora* and *Promachus*. The claws are blunt as in *Mallophora* but the slenderer form and the larger, more conspicuous genitalia and the long ovipositor suggest *Promachus*. The species are less pilose than *Mallophora*.

Genotype. Promachina (*Promachus, Mallophora*) *trapezoidalis* Bellardi, Saggio di Ditterologia Messicana, 2:52 (1861).

Proctacanthella n. gen.

Hitherto included in *Asilus* but suggested as belonging to *Erax* by Curran. The species differ from *Asilus* in having the "metanotal" slopes bare and in having the ovipositor cylindrical and with a terminal circlet of spines as in *Proctacanthus*. The venation differs from *Proctacanthus* in that the posterior branch of the third vein terminates beyond the tip of the wing as in *Asilus*.

Genotype. Proctacanthella (*Asilus*) *cacopiloga* Hine. Annals of the Ent. Soc. Amer. 2:166 (1909).

ANNOTATED LIST OF SPECIES[4]

1. **Leptogaster brevicornis** Loew. Centuria 10:23 (1872). "Texas" (Loew).
2. **Leptogaster incisuralis** Loew. Berlin Zeitschr. VI, 190, 11 (1862). Bexar County, Sept. 20 (H. B. P.).
3. **Leptogaster eudicranus** Loew. Berliner Ent. Zeits. 18: 353 (1874). "Texas" (Loew).
4. **Leptogaster scapularis** Bigot. Annales de Soc. Ent. de France, 444 (1878). Austin, April 30, 1921 (R. H. P.).
5. **Leptogaster tenuipes** Loew. Centuria 2: 14 (1862). "Texas" (U. S. N. M.) (Back). Bexar County, June 17, 1928 (H. B. P.). Austin, July 16, 1923 (Painter).
6. **Leptogaster virgatus** Coquillett. Proc. Ent. Soc. Wash., 6: 177 (1904). "Texas" (Belfrage).
7. **Leptogaster texanus** n. sp. This species was collected by the writer in the shade of a large tree in a weedy pasture in the Brazos Bottoms, Burleson County. Numerous specimens in Tex. Expt. Sta. Collection, April 24–June 23, mostly collected by H. J. Reinhard. Austin, May 19, June 10, 1921 (Painter).
8. **Leptogaster murinus** Loew. Cent., 2: 9 (1862). One female, Waxahachie, May 23, 1933 (S. E. McG.).
9. **Psilonyx** (**Leptogaster**) **schaefferi** Back. Trans. Amer. Ent. Soc. 35: 170 (1909). Brownsville (Back).
10. **Townsendia pulcherrima** Back. Trans. Amer. Ent. Soc. 35: 177 (1909). This very small species was collected in numbers along the sandy borders of a stream bed near Millican, Brazos Co., May 24–June 15. Travis and Atascosa Counties, April 4–May 1.

    Prey. Female, a small empid, June 5.
11. **Ablautus mcgregori** n. sp. Uvalde Co., Sept. 12, 1932 (S. E. McG.).
12. **Ablautus rufotibialis** Back. Op. cit., p. 182. Ysleta, April 2, 1902 (Back).
13. **Ospriocerus eutrophus** Loew. Berliner Ent. Zeits. 355 (1874). "Pecos River." "Texas" (A. N. S. P.). Austin, June 19 (Painter).

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[4]Remarks and dates, unless otherwise indicated, refer to the College Station area. Prey records, unless otherwise noted, were collected by the writer. In recording the prey, the sex of the Asilid captor is given first, followed by the name of the prey and finally the date. Where no year is mentioned, 1932 is understood.

14. **Ospriocerus rhadamanthus** Loew. Centuria 7: 52 (1866). "Pecos River." Bexar Co., June 20–26 (H. B. P.), June 10, 1929 (Parks) (Wilcox).

15. **Ospriocerus abdominalis** Say. Long's Expedition, Appendix, 375 (1824); Complete Works, 1: 255. Austin, April 16–May 6 (U. T.). Comfort, July 19, 1921 (R. K. F.). Bexar Co., July 18, 1931 (H. B. P.). Round Mt. (A. N. S. P.).

16. **Ospriocerus parksi** n. sp. Bexar Co., May 6–29 (H. B. P.).

17. **Ospriocerus ventralis** Coquillett. Ent. News, 9: 37 (1898). El Paso, vi–21 (Duncan); Tornillo Creek, Brewster Co., vii–20 (Duncan) (Cole).

18. **Stenopogon aeacidinus** Williston. Trans. Amer. Ent. Soc., 13: 289 (1866). This species was common in mesquite pastures at Spur, alighting on the ground. The following prey records are from Spur. Bexar Co., Aug. 24–Oct. 9 (H. B. P.). Spur, Sept. 10–15, 1932 (Bromley and O'Dowd). Brownwood, Sept. 16, on dead mesquite branches (R. H. Painter), Abilene, ix–15 (Painter) (F. R. Cole).

Prey. Female, a small syrphid, Sept. 11. Female, a blister beetle, *Epicauta cinerea* Forst, Sept. 11. Male, a smaller male *S. aeacidinus*, Sept. 12. Female, a stink bug, *Thyanta custator* Fabr., Sept. 12.

19. **Stenopogon texanus** Bromley. Ann. Ent. Soc. Amer., 24 (2): 431, (1931). Dilley, May 5–6, 1920 (H. J. R.). Marble Falls, April 4–21, 1923 (C. A. Harned). Christoval, April 27, 1915 (A. K. Fisher). San Angelo, April 12, 1932 (S. E. Jones).

20. **Stenopogon cinerascens** Back. Op. cit., p. 208. Floresville, July 15, 1932, several specimens collected in apiary in mesquite pasture (S. E. McG.). Pearsall, Aug. 13, 1932 (S. E. M.). Kingsville, July 6–7 (Hull); Odessa, July (Hull) (R. H. P.).

21. **Stenopogon helvolus** Loew. Berliner Ent. Zeits. 355 (1874). "Texas." Brownwood, Sept. 13 (R. H. P.). Spur, Sept. 11, 1932 (Bromley & O'Dowd).

22. **Stenopogon tenebrosus** Coquillett. Jour. N. Y. Ent. Soc., 12: 33 (1904). "Southern Texas" (Back). Bexar Co., June 7–24, 1929 (H. B. P.).

23. **Stenopogon latipennis** Loew. Centuria, 7: 49 (1866). (Pl. I, Fig. 5.) A common species in weedy pastures in the bottom lands of Brazos County. May and June. Dimmit, Frio, Bexar, Dickens, Brown, Pecos, Ector Counties. Early May–Aug. 10.

Prey. Male, small grasshopper nymph, *Melanoplus* sp., June 11, 1932. Female, stink bug, *Chlorochroa uhleri* Stal., June 11, 1932.

24. **Stenopogon subulatus** Wiedemann. Auss. Zweifl. Ins. 375 (1828). Fairly common in grassland or open woods in sandy uplands. June 26–Aug. 27. "Pecos River" (Back). Jackson Co., Aug. (Duncan) (Cole).

Prey. Female, grasshopper, *Melanoplus* sp., June 26.

25. **Stenopogon longulus** Loew. Centuria, 7: 50 (1866). El Paso, June 29, 1921 (C. D. Duncan) (F. R. Cole).

26. **Stenopogon nitens** Coquillett. Jour. N. Y. Ent. Soc., 12: 34 (1904). Southern Texas, May (Back).

27. **Stenopogon pumilus** Coquillett. Op. cit. 33 (1904). "Brownsville, April–May" (Back).

28. **Dizonias tristis** Walker. Diptera Saundersiana, 93 (1856). (Pl. II, Fig. 6.) Found along water courses or cultivated fields where vegetation is rank. The black male is mimetic of a psammocharid or sphecid wasp, while the brown and black female resembles a *polistes*. Brazos, Dallas, Madison, Williamson, Brewster, Bexar, Burleson, Travis Counties, June 26–Oct. 28.

Prey. Female, a blister beetle, *Epicauta* sp., June 12, 1932.

29. **Microstylum galactodes** Loew. Centuria, 7: 44 (1866). (Pl. II, Fig. 4.) Occurs in the central and western portions of the state. A large, striking species. Pecos, Brewster, Frio, Bexar, Webb, Jim Hogg, Brown, Jeff Davis, Presidio, Brooks, Starr, Ector Counties, June 16–Aug. 13.

30. **Microstylum morosum** Loew. Centuria, 10: 27 (1872). (Pl. I, Fig. 9.) This "green-eyed monster" is probably the largest asilid occurring in North America. I have found it rather common in the open woodlands and adjoining cotton fields in the bottom lands along the Trinity and Bosque rivers. Its huge size, dark color, and emerald-green eyes impart an antedeluvian appearance as it rests on a dead branch of a tree, its intent watching for prey betrayed by the quick pivotal movements of the head surmounting the stiltlike neck. Grasshoppers and cicadas are the most common prey. *M. morosum* is not very wary; when taking flight, the female flies with a low, deep-toned buzz, the male with a

whirr, like that of a *polistes* or large spider wasp. Flight seems somewhat labored and uncertain, the long posterior legs dangling in the air. When feeding, the fly frequently hangs partly suspended by a front leg in a manner similar to that of *Diogmites* and *Saropogon*. Messrs. W. T. Davis and George Engelhardt found this species common at Marathon in 1931. The males are black, sometimes with a bluish bloom, while the females are dimorphic, some being largely black, others having the legs and abdomen more or less reddish. The latter form was given specific rank at one time (*pollens* O. S.). It is undoubtedly only a phase of this species. Dallas, McLennan, Bosque, Madison, Victoria, Travis, Mills, Brewster Counties, June 28–Aug. 26.

Prey. Female, the cicada (*Tibicen resh* Hald.), Madison Co., Aug. 10, 1930 (Bibby & O'Dowd). Female, the cicada (*Diceroprocta vitripennis* Say), Madison Co., Aug. 1, 1932 (Bibby & O'Dowd). The cicada (*D. vitripennis* Say), Madison Co., Aug. 1, 1932 (Bibby & O'Dowd). Female, the cicada, *D. vitripennis* Say, Madison Co., Aug. 4, 1932 (S. W. B.). Female, the grasshopper, *Mermeria maculipennis* Bruner (Det. V. A. Little), Valley Mills, July 24, 1932 (S. W. B.).

31. **Ceraturgus dimidiatus** Macquart. Dipteres Exotiques, Supplement 2: 51 (1847). "Dallas" (Back).

32. **Plesiomma unicolor** Loew. Centuria 7: 35 (1866). "West Texas, July 17, O. S." (Back). "Cotulla, LaSalle Co., J. C. Crawford, May 5" (Back). Bexar Co., May 3 & June 12, 1928 (Parks) (J. Wilcox).

33. **Holcocephala abdominalis** Say. Jour. Acad. Sc. Phila., 3: 50, (1823); Complete Works, 2: 64. "Texas" (Back).

34. **Holcocephala calva** Loew. Centuria 10: 35 (1872). "Texas" (type).

35. **Holcocephala bullata** n. sp. Bexar Co., May 20–June 7 (H. B. P.)

36. **Holopogon texanus** n. sp. Male and Female, Bradley, July 25, 1921; Bradley, Brownwood, May; Junction, July 21–Aug. 30. (All R. H. P.). "On tip of dead broomweed; resting on dead twig of sumac." The Junction specimen "on tip of dead button willow" (Painter).

37. **Holopogon phaeonotus** Loew. Berliner Ent. Zeits., 366, (1874). "Texas" (type).

38. **Holopogon lautus** Coquillett. Jour. N. Y. Ent. Soc., 12: 33 (1904). "Texas" (type).

39. **Holopogon atripennis** Back. Op. cit., 312. Bexar Co., Sept. 11, 1932 (H. B. P.).

40. **Holopogon snowi** Back. Op. cit., 316. McLennan Co., June 18, 1933 (H. B. Mills). As prey of *Atomosia puella*.

41. **Heteropogon johnsoni** Back. Op. cit., 320. "Brownwood, Sept. 13, resting on tips of dead twigs of mesquite, etc." (R. H. P.). Austin, Sept. 9–Oct. 30 (R. H. P.).

42. **Heteropogon lautus** Loew. Centuria, 10: 34 (1872). "Texas" (type) Belfrage. Common in mesquite pastures at Spur, Sept. 10–16, 1932, alighting on tips of dead twigs, fence wire, bark, and similar positions. Four were seen with small winged ants as prey. Bexar, Travis, Brown, Taylor, Tom Green, Dickens, Bailey Counties, Sept. 8–Oct. 30.

43. **Heteropogon senilis** Bigot. Ann. Soc. Ent. Fr., 423 (1878). Austin, Oct. 4–30 (F. R. Cole).

44. **Heteropogon patruelis** Coquillett. Can. Ent., 25: 21 (1893). "Texas" (type) (H. K. Morrison). Austin, Sept. 20–Oct. 22 ("Mouth of Pedinales River.") (R. H. P.).

45. **Heteropogon phoenicurus** Loew. Centuria 10: 33 (1872). "Texas" (type). Belfrage.

46. **Stichopogon trifasciatus** Say. Jour. Acad. Sci. Phila., 3: 51 (1822); Complete Works, 2: 64. This widely distributed common species occurs on bare, sandy, or gravelly areas and feeds to a considerable extent on small spiders. Brazos, Madison, Frio, Bexar, Travis, Burleson, Starr Counties. Early May to Nov. 4.

Prey. Female, small attid spider, Warda, July 10, 1932. Female, small attid spider, Madison Co., July 12, 1932.

47. **Stichopogon abdominalis** Back. Trans. Amer. Ent. Soc., 35: 332 (1909). "Texas" (C. Palm) (A. M. N. H.). Bexar Co., Sept. 21, 1932 and Oct. 13, 1931 (H. B. P.) (J. Wilcox).

48. **Stichopogon colei** n. sp. Brewster Co., May 9, 1927 (J. O. Martin). Bexar Co., Sept. 17–Oct. 20 (H. B. P.).

49. **Saropogon abbreviatus** Johnson. Psyche, 10: 113, 1903. San Antonio (type). Cotulla (J. C. Crawford), May 5, 1905. Bexar Co., June 20, 1932 (H. B. P.) (F. R. Cole). McAllen, July 1, 1921, collected by F. M. Hull (R. H. P.).

50. **Saropogon coquillettii** Back. Trans. Amer. Ent. Soc., 35: 348 (1909). Laredo, Aug. 7 (Back). Laredo Co., July 8, 1900 (Wheeler Coll.) (A. M. N. H.). Finlay, Aug. 11, 1930 (Winburn and Painter). Kingsville (Painter).

51. **Saropogon combustus** Loew. Berliner Ent. Zeits., 373 (1874). A dimorphic species, the male black, the female reddish. "Clarendon, Aug. 11 (C. R. Jones)" (Back). Pearsall, June 19, 1928. Brewster Co., June 24, 1929 (H. B. P.). Marathon, vii–14 (Duncan) (Cole).

52. **Saropogon pritchardi** n. sp. Mills Co., July 20, 1931 (R. H. P.).

53. **Saropogon fletcheri** n. sp. Comfort, July 19, 1921 (R. K. Fletcher). Austin, May 21–July 17; Ozona, Aug. 28, 1924; Brownwood, Aug. 21, 1931 (Painter).

54. **Saropogon dispar** Coquillett.[5] Jour. N. Y. Ent. Soc., 10: 139 (1902). (Pl. II, Fig. 5.) One of the commonest of the so-called "bee-catchers." Mr. H. B. Parks reports that in the San Antonio region it is abundant around apiaries and is destructive to bees. It frequently selects the virgin queens, and its depredations on these make it of serious economic importance. Mr. Parks has killed over 700 of this species in a bee yard in three days. The bees recognize *S. dispar* as an enemy and when it has the temerity to alight too close to the hive will attack it en masse and sting it to death. Mr. Parks informs me that he has seen the dead bodies of many of this species around the hives. Although *S. dispar* apparently prefers honey bees where available, its menu is rather varied and includes bees, wasps, heteroptera, grasshoppers, and diptera. On July 11, 1932, at College Station, I watched a female of this species for ten minutes unsuccessfully attempt to puncture a boll weevil which it had captured. Finally the fly dropped the weevil which was still alive but covered with saliva and apparently crippled. *S. dispar* is dimorphic in both sexes, the male generally predominantly blackish and the female reddish. Both sexes fly rather erratically with a dull buzzing, alighting on plants or shrubs, and frequent cultivated fields in addition to fallow or pasture land. In June, when the corn is tasseling and attracting many insects, *S. dispar* may be found in cornfields; later as the corn dries and becomes less attractive, the flies move to the cotton patches which are then beginning to bloom. Brazos Co., June and July. McLennan, Colorado, Burleson, Brown, Bexar, Cameron, Hidalgo, Starr, Brooks, Jim Hogg, Dimmit, Frio, Uvalde, Travis, Kleberg, Pecos, Brewster, Wilson, Atascosa, Tom Green, Medina Counties, June 10–Aug. 28.

Prey.—Hymenoptera. Three males, two females, all with honey bee workers, July 15, July 15, July 23, July, June 28, all 1932, Bexar Co. (H. B. P.). Male, honey bee, July 15, 1932 (J. C. Gaines). Two males, honey bees, July 4 and 14, 1932. Male, green bee (*Agapostemon* sp.?), June 28, 1932, Bexar Co. (H. B. P.). Female, solitary bee, *Andrena* sp., June 12, 1932. Female, wasp, *Polistes annularis* L., July 4, 1932. Female, wasp, *Polistes annularis* L., June 21, 1932 (J. C. Gaines). Female, wasp, *Polistes* sp., July 25, 1932. Female, wasp, *Polistes* sp., 1932, Bexar Co. (H. B. P.). Male, small larrid wasp, June 25, 1932. Male, small larrid wasp, June 25, 1932. Female, spider wasp (*Lophopompilius* sp.), June 28, 1932 (J. C. Gaines). Female, sand wasp, *Priononyx* sp., June 27, 1932. Female, blue mud wasp (*Chalybion coeruleum*), July 11, 1932. Male, mud wasp (*Sceliphron cementarium*), July 13, 1932. Female, mud wasp (*S. cementarium*), July 14, 1932. Female, scoliid wasp (male), June 29, 1932. Male, mud wasp, *Sceliphron cementarium*, Brownwood, Aug. 15, 1924. Female, andrenid bee, Brownwood, Aug. 28, 1931 (Painter).

Diptera. Male, bee fly (*Anthrax lucifer* Fabr.) June 26, 1932. Male, bee fly (*Anthrax* sp.), June 12, 1932. Male, soldier fly (*Hermetia illucens*), July 11, 1932. Male, gray drone fly (*Eristalis aeneus* Fabr.), June 27, 1932.

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[5]This species was pictured in the American Bee Journal, February, 1924, p. 79, in an article on "Robber Flies" by Frank C. Pellett. The statement was made that this species "seemed to be far more destructive to the honey bees than any other species observed on the trip."

Orthoptera. Female, small grasshopper nymph, *Melanoplus* sp., June 29, 1932. Male, grasshopper, *Orphulella* sp., June 12, 1932.

Hemiptera. Male, leaf-footed plant bug (*Leptoglossus phyllopus*), July 14, 1932. Male, small coreid bug, July 3, 1932.

55. **Diogmites (Deromyia) hypomelas** Loew. Centuria, 7: 42 (1866). "Pecos River" (type).

56. **Diogmites sallei** Bellardi. Saggio di Ditt. Messic. 2: 70, 8 (1861). Metz, Aug. 12, 1930 (Winburn and Painter).

57. **Diogmites perplexus** Back. Trans. Amer. Ent. Soc., 35: 360 (1909). Two specimens in collection of Department of Entomology, Texas A. & M. College. Unlabeled but probably collected by students in western part of state.

58. **Diogmites texanus** n. sp. Found in open woods and adjoining cotton fields on alluvial plains. Trinity River bottoms, Madison Co., June 28–Aug. 14.

Prey.—Male, cotton leafworm moth, *Alabama argillacea* Hbn. (Bibby & O'Dowd). Female, small spider wasp (*Psammocharid*), July 24, 1932. Female, small halictid bee, July 24, 1932. Female, green halictid bee, Aug. 9, 1932.

59. **Diogmites angustipennis** Loew. Centuria, 7: 41 (1866). (Pl. I, Fig. 7). Distinguished with difficulty from *symmachus*. In the field, *angustipennis* appears stouter and flies with a higher-pitched buzz. The male frequently flies with the abdomen curved forward under the body. This species is very common in the Brazos Bottoms, in cotton fields, pasture, or waste land. Alluvial soil is the preferred habitat of *angustipennis*, while *symmachus* is a species of higher, sandier soil. Flies with a high-pitched buzz, darting hither and thither among the cotton plants, and preying on honey bees, wasps, and other insects. *D. angustipennis* is cannibalistic to a high degree, and the male risks his life in approaching the female, who frequently kills and devours him on sight. In several cases where I have noted this species *in coitu*, the female has been in an almost teneral condition indicating recent emergence. Where females were taken preying on males, the former were old, fully pigmented individuals. Burleson Co., July and August. Brazos, Madison, Harris, Galveston, Bailey, Dickens, Cameron, Hidalgo, Pecos, Brewster Counties. May–October.

Prey.—Hymenoptera. Female, honey bee, July 22, 1932. Male, honey bee, Aug. 12, 1932. Male, honey bee, Aug. 8, 1932. Male, green halictid bee, Aug. 12, 1932. Male, orange-winged spider wasp, *Priocnemis* sp., July 30, 1932. Male, larrid wasp, July 15, 1932. Female, small wasp, *Polistes* sp., Aug. 8, 1932. Male, halictid bee, Aug. 3, 1932. Port Lavaca, Aug. 12, 1925, a female with small sphecid wasp.

Diptera. Female, same species *D. angustipennis* male, Aug. 7, 1932. Female, same species, *D. angustipennis* male, Aug. 18, 1932. Female, same species, *D. angustipennis* male, Aug. 7, 1932. Female, same species, *D. angustipennis* male, Aug. 8, 1932. Female, asilid fly, *Proctacanthella cacopiloga* Hine male, July 29, 1932. Male, asilid fly, *P. cacopiloga* male, Aug. 3, 1932.

Coleoptera. Female, a small histerid beetle, Aug. 10, 1932.

60. **Diogmites symmachus** Loew. Centuria, 10: 26 (1872). (Pl. I, Fig. 8). One of the most abundant "bee-catchers." In Brazos County, this species is much more abundant than *Saropogon dispar*, while at San Antonio the reverse is true. *D. symmachus* frequents bee-yards and undoubtedly destroys many bees. On several occasions, Dr. Bilsing has noted individuals approaching the hives, attacked and killed by the bees, not, however, without a prolonged struggle. Moreover, the frequency with which dead *Diogmites* are found outside the hives indicates that the bees will not tolerate them long in the vicinity of the apiary. *D. symmachus* is an active, voracious feeder, preying on many large insects, but showing a preference for Hymenoptera. Although less robust than *S. dispar*, it is more agile and aggressive, and on two occasions I have taken individuals feeding on *S. dispar*. Brazos, Burleson, Madison, Bexar, Harris, Galveston, Travis, McLennan, Dallas, Washington, Grimes, Bosque, Brown, Collins, Ector Counties, June 4–Oct. 14. On Sept. 23, 1932, Mr. S. E. McGregor sent in a very large female which was found dead at the entrance of a hive in Dallas Co.

Prey.—Hymenoptera. Female, worker honey bee; female, small worker paper wasp (*Polistes* sp.), Burleson Co., Oct. 1, 1932 (R. K. F.). Female, honey bee, Bexar Co., Aug. 16, 1931 (H. B. P.). Female, honey bee, July 14, 1932 (J. C. Gaines). Male, honey bee, July 22, 1932. Two females, honey bees, July 24,

1932, Valley Mills. Female, honey bee, July 16, 1932. Female, honey bee, Aug. 21, 1932. Female, honey bee, July 22, 1932. Female, melon bee, *Melissodes* sp., June 29. Female, melon bee, *Melissodes bimaculatus* Le P., July 13. Female, melon bee, *Melissodes* sp., July 13, 1932. Female, melon bee, *Melissodes* sp., July 14. Female, large melissodes bee, Aug. 21, 1932. Female, large melissodes bee, Aug. 22, 1932 (R. K. F.). Female, large melissodes bee, July 31, 1932 (J. C. Gaines). Male, worker bumble bee, *Bombus americanorum* (U. T.). Female, worker bumble bee, *Bombus americanorum*, Aug. 10, 1932 (J. C. Gaines). Female, solitary bee, *Andrena* sp., July 23. Male, solitary bee, *Andrena* sp., July 7. Female, leaf-cutter bee, *Megachile* sp., Aug. 21. Female, wasp, *Polistes annularis*, Valley Mills, July 24. Female, wasp, *P. annularis*, Valley Mills, July 24. Female, wasp, *Polistes annularis* L., June 5, 1932 (H. J. R.). Female, wasp (*P. annularis* L.), July 4. Female, wasp, *P. annularis* L., July 13, 1932 (J. C. Gaines). Female, wasp, *Prononyx atratum*, Aug. 21. Female, wasp, *Polistes texanus*, July 3. Female, wasp, *Polistes canadensis*, Aug. 8. Female, wasp, *Polistes* sp., Aug. 7, 1932 (S. E. McG.). Female, wasp, *Tachytes* sp., Aug. 21. Male, small wasp, *Tachysphex* sp., July 27. Male, *Tachysphex* sp., July 23. Male, *Tachysphex* sp., July 23. Female, Potter wasp, *Eumenes* sp., July 23. Female, Potter wasp, *Eumenes* sp., July 4. Female, wasp, *Odynerus* sp., July 3. Female, male mutillid, *Dasymutilla* sp., June 19. Female, wasp, *Prononyx* sp., June 25. Female, small wasp, *Ancistrocerus* sp., Aug. 11. Male, small spider wasp, *Episyron* sp., July 3. Female, spider wasp, *Lophopompilius* sp., July 7. Male, small wasp, *Cerceris* sp., July 6. Female, solitary wasp, *Cerceris* sp., July 11. Male, small wasp, *Cerceris* sp., June 22. Male, mud wasp, *Sceliphron cementarium*, June 26. Female, mud wasp, *S. cementarium*, June 23. Female, mud wasp, *S. cementarium*, Aug. 26. Female, scoliid wasp, *Campsomeris plumipes*, July 10. Male, scoliid wasp (male), *Campsomeris plumipes*, June 19. Female, scoliid wasp (male), *C. plumipes*, June 19. Female, scoliid wasp (*Campsomeris* sp.), Waco, July 31. Male, scoliid wasp (male), *C. plumipes*, June 16. Male, Ibid, June 29. Male, Ibid, July 4. Male, Ibid, July 4. Male, Ibid, July 4. Female, harvester ant, (female) *Pogonomyrmex barbatum*, June 27.

Diptera. Female, the asilid female, *Dizonias tristis*, Sept. 30. Female, teneral *D. symmachus* female, Valley Mills, July 24. Female, another female of same species (*D. symmachus* Loew), Oct. 14. Female, *D. symmachus* male, July 4. Female, asilid fly, *Stenopogon latipennis* Loew, June 19. Female, Ibid, June 12. Male, *Asilus rubicundus*, July 3. Female, *Stenopogon subulatus* male, July 9. Female, *Stenopogon subulatus* male, July 9. Female, *Stenopogon subulatus* female, July 2. Female, *Saropogon dispar* male, July 14. Female, *Saropogon dispar* female, June 12. Female, very large *Promachus bastardi* male, June 26. Female, *Stichopogon trifasciatus*, June 19. Male, soldier fly, *Odontomyia* sp., July 24, Valley Mills. Male, small syrphid fly, June 11. Male, gray drone fly, *Eristalis aeneus*, July 1. Male, bee fly, *Anthrax* sp., July 3. Female, soldier fly, *Hermetia illucens*, July 13. Male, flower fly, *Eristalis vinetorum* Fabr., July 7. Male, screw worm fly, *Cochlyomyia macellaria*, Sept. 30.

Lepidoptera. Male, skipper, *Hylephalis* sp., Aug. 8. Male, small noctuid moth, June 11. Female, Celtis butterfly, *Chlorippe celtis*, July 3. Female, small frittilary, *Phyciodes* sp., July 4. Male, small yellow butterfly, *Nathalis iole*, July 13. Male, Ibid, July 13. Female, cotton leafworm moth (*Alabama argillacea*), Oct. 6, 1932.

Hemiptera. Male, "sharpshooter," *Homalodisca triquetra*, June 11. Male, squash bug, *Anasa tristis* DeG., July 6. Female, stink bug, *Euschistus servus*, Aug. 26. Female, stink bug, *Euschistus servus*, Aug. 29. Male, stink bug, *Menecles insertus*, June 25. Female, leaf-footed plant bug, *Leptoglossus phyllopus*, July 4. Male, assassin bug, *Apiomerus spissipes*, Aug. 8, 1932.

Odonata. Male, dragonfly, *Perithemis domitia*, June 25.

Orthoptera. Grasshopper, Sept. 29 (F. F. B.).

Arachnida. Female, lycosid spider, June 20.

61. **Diogmites misellus** Loew. Centuria, 7: 39 (1866). Wharton, Aug. 9 (C. D. Duncan) (Cole).

62. **Diogmites neoternatus** Bromley. Ann. Ent. Soc. of Amer., 24 (2): 432 (1931). Round Mountain (Back). Trans-Pecos Region, 1916 (F. M. Gaige) (Hine). Brownwood, Aug. 3, 1920, "Has black-haired palpi and is light brown

in color," (R. H. P.). Brownwood, Aug. 11, 1932 (Painter). Ennis, viii–16 (Duncan) (Cole).

63. **Taracticus octopunctatus** Say. Jour. Acad. Sci. Phila., 3: 49 (1823). Complete Works, 2: 63. May 25–30 (H. J. R.). Erath Co., June 9, 1929.

64. **Nicocles reinhardi** n. sp. Nov. 1, 1927 (H. J. R.). Bexar Co., ix–21, 1931 (H. B. P.) (J. Wilcox).

65. **Cophura bella** Loew. Centuria, 10: 24 (1872). "Texas."

66. **Cophura texana** n. sp. Comfort, July 21, 1921 (R. K. F.). Brownwood, June 12–July 21; Austin, July 21, 1924 (R. H. P.).

67. **Cophura lutzi** Curran. Amer. Mus. Nov., 487, 7 (1931). Ten specimens, Hidalgo Co., June 11, 1933 (J. W. Monk).

68. **Psilocurus nudiusculus** Loew. Berliner Ent. Zeits. 18: 370 (1874). Common along sandy banks of streams or gullies, alighting on twigs or stones. Resembles *Stichopogon trifasciatus* in habits. Burleson Co., July and August. Brazos, Madison, Bexar, Brown, Travis, Cameron, Hidalgo Counties, May 18–Aug. 22. Brownwood, June 25–Aug. 22, "on low bunches of corn flowers that skirt a dust road, closely match half-dead dusty leaves." (R. H. P.).

Prey.—Female, small leafhopper, July 28. Female, small spider, Aug. 17. Male, small spider, June 29. Austin, June 25, 1924, male, small cercopid (R. H. P.).

69. **Psilocurus birdi** Curran. Amer. Mus. Novitates, No. 487, New American Asilidae, 2: 9 (1931). Along shady banks of streams. May 30 to July 4. College Station, v–21 & vii–4 (H. J. Reinhard) (J. Wilcox). Dickinson, June, 1929 (R. H. P.).

70. **Psilocurus puellus** n. sp. Bexar Co., May 9, 1931 (H. B. P.). Taylor, May 13, 1929 (J. C. Gaines). Brownwood, June 7 (R. H. P.).

71. **Psilocurus modestus** Williston. Kans. Univ. Quarterly, 2: 67 (1893). Taylor, May 13, 1929 (J. C. Gaines) and May 25, 1928 (Gaines & McCoy). May 28, 1929 (J. C. Gaines). Brownwood, July 16–21, 1921, "in long grass in damp pasture;" Austin, May 14, 1921, "resting on dead twig at head of first canyon below dam on Colorado;" Kingsville, June 13, 1921 (F. M. Hull) (R. H. P.).

72. **Laphystia albiceps** Macquart. Dipteres Exotiques, Supplement 1: 69 (1845), "Texas."

73. **Laphystia sexfasciata** Say. Jour. Acad. Sci. Phila., 3: 50 (1822). Complete Writings, 2: 64.

74. **Laphystia opaca** Coquillett. Proc. Ent. Soc. Wash., 6: 180, July (1904). "Padre Island, June 29."

75. **Laphystia notata** Bigot. Ann. Soc. Ent. Fr., 433 (1878). Galveston, June, 1900 (Wheeler Coll.) (A. M. N. H.). Dickinson, June, 1929 (R. H. P.).

76. **Laphystia texensis** Curran. Amer. Mus. Novitates, No. 487, 14 (1931). "Galveston, June 5, 1900 (Wheeler Coll.)" (Curran). Galveston Island, Aug. 9 (R. H. P.). Galveston, Oct. 8, 1932 (R. K. F.) (1 male; 1 female).

77. **Atomosia puella** Wiedemann. Auss. Zweifl. Ins., 1: 531 (1828). The most abundant species of the genus. Rests, usually in a head-downward position, on trunks of trees, posts, buildings, stones, or fences. Brazos, Burleson, Madison, Harris, Bexar, Crockett, Travis, Mills, Brown, Cameron, Hidalgo, McLennan Counties, May 9–Sept. 11.

Prey.—Female, chinch bug, *Blissus leucopterus*, June 13, 1932. Brown Co., June 6, 1929, male, small bibionoid fly. (R. H. P.).

78. **Atomosia rufipes** Macquart. Dipteres Exotiques, Supplement 2: 39 (1847). A rare species of wide distribution. June 19, 1928 (H. J. R.).

79. **Atomosia mucida** Osten Sacken. Biol. Centr. Amer. Diptera, 1: 184 (1887). April 10–June 19 (H. J. R.). Bexar Co., May 3, 1929 (H. B. P.) (Bromley).

80. **Atomosia glabrata** Say. Jour. Acad. Sci. Phila., 3: 53 (1822). Complete writings, 2: 66. A rare species of wide distribution. Houston, May 27, 1921 (H. J. R.).

81. **Atomosia sayii** Johnson. Psyche, 10: 113 (1903). June 4–Sept. 13 (H. J. R.). McKinney, Aug. 19, 1929 (J. N. Roney). Houston, May 27, 1921 (Reinhard). Austin, June 10, 1921, "on ragweed" (R. H. P.).

82. **Atomosia soror** Bigot. Ann. Soc. Ent. Fr., ser. 5, viii, 236 (1878). Austin, June, 1932 (U. T.). Brewster Co., June 24, 1929 (H. B. P.).

83. **Atomosia melanopogon** Hermann. Abhandl. Kaiserl. Leopoldisch-Carolinischen Deutsch. Akad. Naturf., 96: 144 (1912). Similar to *A. puella* in habits. Brazos, Bexar, Brown, Travis, Crockett, Hidalgo Counties, May 22–Aug. 24. Brownwood, June 16–Aug. 18, "numerous specimens, seven taken at graveyard on stone and cement curbing." (R. H. P.).

84. **Atomosia punctifera** Hermann. Op. cit., p. 161 (1912). June 9–Aug. 10 (H. J. R.). Comfort, July 28, 1921 (R. K. F.). Brownwood, July 6–Aug. 23, "on weeds in shady, partly moist situations;" Austin, July 6, 1924 (R. H. P.).

85. **Laphria melanogaster** Wiedemann. Diptera Exotica, 236 (1821). Macquart Dipteres Exotiques, Supplement 1: 75 (1845). "Texas." Not since recognized.

86. **Laphria saffrana** Fabricius. Systema Antliatorum, 160 (1805). A beautiful species mimetic of female *Vespa carolina*. Found in open woods or near logs or stumps. Austin, May, 1931 (U. T.).

87. **Bombomima flavicollis** Say. Long's Expedition, Appendix, 374 (1824); Complete Works, 1: 255. (Pl. I, Fig. 10). A widely distributed species occurring about logs or stumps and in open woodland. March 22–May 15. Milano, March 29, 1929. Broad Top (A. N. S. P.). Hamilton Pool, May 12, 1924 (R. H. P.).

88. **Bombomima lata** Macquart. Dipteres Exotiques, Supplement 1: 78 (1845). A huge, black and yellow haired species, mimetic of a large queen bumble bee, *Bombus americanorum*. Although the type locality is Galveston, I have not found this species in any Texas collection. Its range extends into Kansas, Missouri, and Illinois. In Texas, it is probably confined to the eastern part of the state. *B. lata* is the largest species of *Bombomima*. One of the largest individuals that I have seen was collected near Natchitoches, La., about 45 miles from the Texas line.

89. **Bombomima macquartii** Banks. Bull. Brookl. Ent. Soc., 12 (3): 54 (1917). (Pl. I, Fig. 6). Smaller than *lata*, but also mimetic of *Bombus americanorum*. March 25–May 15. Austin, May, April, and June (U. T.). Plane River (A. N. S. P.).

90. **Bombomima nigella** n. sp. Austin, May 21, 1921 (R. H. P.) (Painter Coll.).

91. **Lampria bicolor** Wiedemann. Auss. Zweifl. Ins., 1: 522 (1828). (Pl. II, Fig. 2). Rather common on or around logs and stumps of post oak. May 23–July 4. (H. J. R.). Brownwood, June 8. (R. H. P.).

92. **Lampria rubriventris** Macquart. Hist. Nat. de Dipt., 1: 284 (1834). Mr. Reinhard called my attention to the fact that the habitat of this green-eyed fly is usually quite different from that of its congener, *L. bicolor*, being found more frequently in rather long grass in fields and meadows. The only specimen that I collected was in such a location. May 22, 1932, numerous specimens (J. C. Gaines, H. J. Reinhard, F. L. Thomas). June 26, 1932 (S. W. Bromley). Houston, May 27, 1921 (H. J. Reinhard). Brownwood, June 12 (R. H. Painter).

93. **Andrenosoma abdominalis** Brown. Kans. Univ. Quart., 6: 103 (1897). Girvin, Aug. 4, 1931 (R. H. Painter).

94. **Andrenosoma rubidum** Williston. Biol. Centr. Amer. Diptera, 1: 318 (1900). =*sicaria* McAtee. Ohio Jour. Sci., 19 (4): 246 (1919). (Pl. I, Fig. 11). This Mexican and Central American species has been taken in several counties in southwest Texas. It is closely related to *xanthocnema* Wiedemann, from which it differs in having the third joint of the antennae reddish, instead of black. All specimens recorded below except that collected by R. H. Painter were taken in bee yards where they were observed resting on hives or nearby trees. Mr. Parks states that one was noted feeding on a honey bee worker. They are quick of flight, but when at rest they settle down rather flatly on the wood, not standing erect as many asilids do. On an upright surface, they generally rest head down, like *Atomosia puella*. Zavalla, Cameron, Hidalgo, Bexar, Atascosa, McMullen, Karnes, San Patricio, Willacy Counties, April 26–Aug. 24.

Prey.—Honey bee worker, Bexar Co., July, 1932 (H. B. P.). Honey bee worker, Mathis, Aug. 23, 1932 (S. E. McG.).

95. **Andrenosoma fulvicauda** Say. Jour. Acad. Sci. Phila., 3: 53 (1823), Pl. VI and Complete Works, 1: 12. Brownsville, June. F. H. Snow (K. U.) (McAtee). Brownwood, Aug. 16, 1918 (R. H. P.).

Prey.—Male, chalcid, Brownwood, Aug. 16, 1918 (R. H. P.).

96. **Ommatius tibialis** Say. Jour. Acad. Sci. Phila., 3: 49 (1823) and Complete Works, 2: 63 (1859). Dallas, (Coll. Lichtwardt) Berlin Museum (Dr. Horn).

97. **Mallophora acra** Curran. Amer. Mus. Novitates, 487, 21 (1931). (Pl. I, Fig. 2). Occurs in mesquite pastures, flying with a high-pitched querulous buzz and alighting on grass or weed stalks. Dickens, Uvalde, Dimmit, Hidalgo, Brooks, Wilson, Bexar, Kleberg, Kimble Counties, May-Sept.

98. **Mallophora bromleyi** Curran. Amer. Mus. Novitates, 415, 13 (1930). Probably this species, as *fautrix* Williston, Trans-Pecos, 1916, F. M. Gaige (Hine). Kendall, Hunt, Jeff Davis, Brewster, Brown, Tom Green Counties, July and August.

Prey.—Male, small scoliid wasp, Orla, Aug. 5, 1931.

99. **Mallophora orcina** Wiedemann. Auss. Zweifl. Ins., 1: 477 (1828). (Pl. II, Fig. 10). This stout, black and yellow haired, bumble bee-like species occurs in early summer in corn, cotton, cane, and other cultivated fields as well as in pastures or in open or slightly brushy woods. It feeds almost entirely on aculeate Hymenoptera, such as honey bees, *Polistes* wasps and others. Much less common than *Diogmites* sp., and *Saropogon dispar* found in similar locations, it is occasionally abundant in restricted localized areas. Mr. Parks mentioned finding it abundant in a certain sandy cotton patch, while Messrs. McGregor and Heard reported it as occurring in numbers in a watermelon field. Usually alights on the stalk of a plant, or in a bush and may rest for some time after gorging itself with the large prey that it chooses. Brazos, Burleson, Washington, Fayette, Madison, Bexar, Brown Counties, June 24–August 9.

Prey.—Hymenoptera. Male, honey bee, June 30. Female, honey bee, July 1, 1932 (Bibby and O'Dowd). Female, red wasp, *Polistes rubiginosus*, July 3, 1932. Female, wasp, *Polistes annularis*, July 8, 1932. Female, wasp, *Polistes canadensis*, June 23, 1932. Female, wasp, *Polistes texanus*, July 8. Female, mud wasp, *Sceliphron cementarium*, June 26. Male, mud wasp, *S. cementarium*, July 4. Female, wasp, *Isodontia* sp., July 20, 1932 (J. C. Gaines). Female, wasp, (*Isodontia* sp.), Aug. 10, 1932 (J. C. Gaines).

Hemiptera. Male, assassin bug, *Apiomerus spissipes*, Warda, July 10.

100. **Mallophora belzebul** Schiner. Verhandl. Zool.-bot. Ges. Wein, 17: 385, 64 (1867). This huge species is represented from Texas in the U. S. National Museum by three specimens: Uvalde, 1917, (D. C. Parman); Concan, 1910, (F. C. Pratt); and Sonora, 1924, (O. G. Babcock) (J. M. Aldrich). Under date of March 26, 1927, Mr. D. C. Parman wrote me that specimens collected on July 17, 1917, were taken by a ranchman: "For the last week large numbers of the flies have been emerging in a goat pen. They have never been seen except early in the mornings and have never been observed to fly (supposedly they have just emerged as there were several pupae cases in the lot brought in). The ranchman stated that the ground was covered in the goat pens as large as a room 15 x 20 ft. He is an old settler here and he or his neighbors have never seen the fly before. . . . The specimens were all taken near Montel. It was interesting in that several other species commonly found in Mexico and S. America were found here in 1917. It was thought that they were brought in by a tropical storm in August, 1916." The specimens were identified by Mr. Frederick Knab at the National Museum. Chisos Mts., Brewster Co., July 18 (Duncan); Glenn Springs, Brewster Co., July 19 (Duncan) (F. R. Cole).

101. **Mallophora guildiana** Williston. Trans. Amer. Ent. Soc., 12: 60 (1885). Pease River, Bernon, Aug. 20, 1921 (C. D. Duncan) (Cole). Bexar Co., Oct. 14, 1932 (H. B. P.) (Wilcox). Port Lavaca, Sept. 10, 1925 (R. H. P.).

102. **Mallophora fulviventris** Macquart. Dipteres Exotiques, Supplement 4: 77 (1850–51). "Texas."

103. **Promachina trapezoidalis** Bellardi. Saggio di ditterologia Messicana, 2: 28 (1861). (Pl. III, Fig. 4). Brownsville (Hine). Hidalgo Co., May 26, 1930 (J. C. Gaines).

104. **Promachus painteri** n. sp. Austin, May 24, 1922, and July 21, 1924 (R. H. P.). July 21–Oct. 14 (R. H. Painter & F. M. Hull). Ozona, Aug. 24, 1928 (R. H. P.).

105. **Promachus albifacies** Williston. Trans. Amer. Ent. Soc., 12: 63 (1885). "Brady, July 25" (R. H. P.).

106. **Promachus bastardi** Macquart. Dipteres Exotiques, I, 2, 104 (1838). A widespread species, common in Brazos Co., particularly in the open upland post oak woods and adjacent cultivated fields. Around apiaries, it kills many honey bees. Its high-pitched buzz resembles that of a megachilid bee. May–early July. Brownwood, June; Austin, April (R. H. P.).

Prey.—Hymenoptera. Male, small wasp, *Tachysphex* sp., June 20. Female, small wasp, *Solenius* sp., June 12. Male, scoliid wasp, *Campsomeris plumipes*, July 4. Female, parasitic wasp, *Tiphia* sp., June 12. Female, female harvester ant, *Pogonomyrmex barbatum*, June 12. Male, Ibid, June 12. Male, larrid wasp, July 4. Female, female *Pogonomyrmex barbatum*, June 12.

Diptera. Male, male *P. bastardi*, June 12. Female, female *P. bastardi*, June 12. Female, small male *Diogmites symmachus* Loew, June 25.

Coleoptera. Male, small "tumble bug," *Canthon* sp., June 25. Female, long-horned beetle, *Neoclytus acuminatus*, June 25. Female, Ibid., June 12.

Hemiptera. Female, leaf-footed plant bug, *Leptoglossus phyllopus*, June 12. Male, small coreid, June 25. Male, stink bug, *Menecles insertus*, June 12.

Orthoptera. Female, grasshopper, *Orphulella picturata* Scudder (Det., V. A. Little), June 12. Female, Ibid., June 12.

107. **Promachus fitchii** Osten Sacken. Dipt. N. A., 234, note 121 (1858). Four males, one female, Paris, June 25, 1933 (S. E. McG.). The "Nebraska Bee Killer," a distinct enemy of the honey bee.

108. **Promachus texanus** n. sp. (Pl. II, Fig. 7). Common in grasslands and pastures, June. Very similar in appearance and habits to *P. fitchii* O. S.

Prey.—Hymenoptera. Female, worker honey bee, June 5. Female, Ibid., June 23.

Hemiptera. Female, stink bug, *Chlorochroa uhleri*, June 11. Female, stink bug, *Menecles insertus*, June 12.

109. **Promachus magnus** Bellardi. Sagg. di Ditt. Mess., 2: 26 (1861). Together with most other members of the genus, this is a "bee-killer." All specimens collected by S. E. McGregor were in bee yards where they were observed to kill bees. Charlotte, July 11, 1932; Pearsall, Aug. 3, 1932; Uvalde Co., Sept. 14, 1932 (S. E. McG.). "Trans-Pecos, 1916, F. M. Gaige" (Hine). Junction, Aug. 15; Austin, July 21, 1924 (R. H. P.). Chisos Mts., (Duncan) (Cole).

Prey. Male, worker honey bee, Pearsall, Aug. 3, 1932 (S. E. McG.). Male, stink bug (*Chlorochroa*), Austin, July 21, 1924. (R. H. P.).

110. **Promachus minusculus** Hine. Ann. Ent. Soc. Amer., 4: 171 (1911). "Austin, June 7–July 21; Ft. Worth, Aug. 1; San Angelo, Aug. 29" (R. H. P.). Brewster Co., June 24, 1929 (H. B. P.) (J. Wilcox).

111. **Promachus giganteus** Hine. Ann. Ent. Soc. Amer., 4: 172 (1911). (Pl. I, Fig. 2). This large species appears to be confined to the arid, western part of the state. It is one of the largest N. American Asilids. The wings, as may be seen in the illustration, are proportionately very long. Monahans, July 14, 1928 (F. F. B.). "Trans-Pecos;" "El Paso" (Hine).

112. **Promachus hinei** Bromley. Ann. Ent. Soc. Amer., 24: 435 (1931). (Pl. II, Fig. 8). Occurs in low, damp, open woods and adjacent cotton fields. Alights in trees or thickets, is active and wary, flying with a shrill buzz. I found it quite common in the low alluvial woodlands along the Trinity and Bosque Rivers. Burleson, Brazos, Madison, McLennan, Collin, Jefferson, Kendall, Travis, Brown, Williamson Counties, June 4–Aug. 28.

Prey.—Female, worker honey bee, July 23. Female, worker honey bee, July 21. Female, Ibid. Female, wasp, *Polistes annularis* L., July 1. Female, wasp, *Polistes annularis*, Aug. 3, Midway. Female, wasp, *Polistes annularis*, Aug. 10. Female, male mutillid, *Dasymutilla* sp., Valley Mills, July 24. Female, tachinid fly, *Trichiopoda* sp., July 18, Midway. Male, the robber fly, *Diogmites symmachus* Loew, Aug. 3, 1932 (F. F. B.).

113. **Proctacanthus arno** Townsend. Proc. Calif. Acad. Sci., 4: 599 (1895). El Paso (Hine). Trans-Pecos, 1916, F. M. Gaige (Hine). Bexar Co. (H. B. P.) (Wilcox). Coyote L., Bailey Co., Aug. 25 (Duncan) (Cole). Roma, July 24, 1933 (S. W. B.).

114. **Proctacanthus brevipennis** Wiedemann. Auss. Zweifl. Ins., 1: 431 (1828). May 10–24 (H. J. R.). Milano, April 28, 1929. The latter, a female, with worker

honey bee as prey. Found in habitats similar to those of *longus* Wied. Bastrop, May 12, 1922 (R. H. P.).

115. **Proctacanthus** near **nigrifemoratus** Hine. Ann. Ent. Soc. Amer., 4: 161 (1911). Metz, June 16 (R. H. P.).

116. **Proctacanthus longus** Wiedemann. Diptera Exotica, 183 (1821). (Pl. II, Fig. 3). Occurs in sandy fields and pastures near the larger water courses. *P. longus* feeds largely on grasshoppers, pouncing on them in flight with the ferocity of a tiger and frequently seizing large species. On June 5, 1932, below Millican, I noted one that was dragged and kicked by a large grasshopper which the fly had seized and with which it had dropped to the ground, for a distance of several inches before the asilid was able to dispatch its prey. *P. longus* and *P. milbertii* have similar habits, the former occurring in spring and early summer, the latter in the autumn. Brazos, Madison, Bexar, Brooks, Frio Counties, June–early August.

Prey.—Diptera. Female, the asilid fly, *Diogmites symmachus*, June 5. Female, the asilid, *Diogmites symmachus*, June 17.

Orthoptera. Female, grasshopper, *Melanoplus* sp. (H. J. R.), June 5, 1932. Female, Ibid., June 5. Male, Ibid., June 5. Female, Ibid., June 5. Male, Ibid., June 5. Female, grasshopper nymph, *Melanoplus differentialis*, June 5. Female, grasshopper, *Orphulella picturata* Bruner, June 15. Female, grasshopper, *Melanoplus* sp., June 17. Female, grasshopper *Melanoplus* sp., July 18, Midway. Female, grasshopper, *Melanoplus* sp., July 12, Madison Co. Female, long-horned katydid, *Scudderia* sp., June 5. Female, katydid, *Tettigonid*, July (R. K. F.).

Homoptera. Three males and one female recorded as preying on cicadas, probably *Diceroprocta vitripennis*, Madison Co., June 20, 1931 (Bibby and Tate).

Odonata. Female, dragonfly, *Gomphus* sp., June 5.

117. **Proctacanthus milbertii** Macquart. Dipteres Exotiques I, 2, 124 (1838). (Pl. II, Fig. 1). For a discussion of the habits of this species, see my paper on "Bee-Killing Robber Flies," Jour. N. Y. Ent. Soc., 38: 172 (1930). The "Missouri Bee Killer," said by Riley to be destructive to honey bees. Common in fields and pastures. Brazos, Bailey, Bexar Counties. "Staked Plains," August-November.

Prey.—Female, small pyralid moth, Sept. 30. Male, grasshopper, *Melanoplus* sp., Sept. 30.

118. **Proctacanthus hinei** Bromley. Psyche, 35 (1): 13 (1928). Closely related to *P. rufus* and occurs in similar habitats, more frequently along the larger water courses.

Prey.—Female, worker honey bee, July 22. Female, wasp, *Polistes texanus*, Aug. 8. Female, guest bumble bee, *Psithyrus* sp., Aug. 20, 1931, Madison Co. (F. F. B.).

119. **Proctacanthus rufus** Williston. Trans. Amer. Ent. Soc., 12: 74 (1885). This reddish, active species occurs in sandy areas along water courses. Its food habits in Texas correspond very closely with those observed by the writer in Connecticut and reported in Psyche, 30 (2): 41–45. Aculeate Hymenoptera are preferred as prey. Brazos, Washington, Madison Counties, June–Sept.

Prey.—Female, honey bee, Midway, July 5. Male, honey bee, July 23. Female, honey bee, June 5, Madison Co. Carpenter bee, *Xylocopa* sp., Madison Co., Aug. 9, 1932. Female, red wasp, *Polistes rubiginosus*, Aug. 21. Female, Ibid., Aug. 21. Female, Ibid., Aug. 21. Male, small wasp, *Polistes* sp., Aug. 21. Female, red wasp, *P. rubiginosus*, Madison Co., June 2. Female, Ibid., Aug. 11. Female, wasp, *Polistes annularis* L., June 5. Male, Ibid., Aug. 8. Female, Ibid., July 4. Male, winged mutillid, *Dasymutilla* sp., Aug. 21, 1932 (H. J. R.).

120. **Eccritosia amphinome** Walker. List of Diptera in British Museum, 2: 387 (1849). This species is said by Prof. Painter to occur in arroyas in the southwestern part of the state and to feed largely on Hymenoptera. "Brownwood, Sept. 17, 1921, male with vespoid as prey; San Saba, Aug. 25, 1921, male with vespoid as prey" (R. H. P.).

121. **Erax anomalus** Bellardi. Saggio di Ditterologia Messicana, 2: 32. (1861). (Pl. II, Fig. 7). Chisos Mts., July (A. N. S. P.). Trans-Pecos, 1916 F. M. Gaige (Hine). Brewster Co., June 24, 1929 (H. B. P.) (Wilcox).

122. **Erax candidus** Coquillett. Can. Ent. 25: 176 (*Efferia*) (1893). "West Texas." (S. W. B.).

123. **Erax rufibarbis** Macquart. Dipteres Exotiques I, 2, 116 (1838). An abundant autumn species occurring in dry fields and cultivated grounds. Feeds largely on small Hymenoptera, Diptera, Lepidoptera, and Hemiptera. Aug. 31–Nov. 1. Brazos, Dickens, Bexar, Brown, Travis Counties, Aug. 31–Nov. 1. "Austin, Oct. 15, 1921, an abnormal individual with three submarginal cells in both wings." (R. H. P.).

Prey.—Male, male *E. rufibarbis*, Sept. 21. Male, cotton leafworm moth. *Alabama argillacea*, Sept. 30. Male, Ibid. Male, Ibid. Female, Ibid. Male, small grasshopper nymph, same date. Male, sarcophagid fly, same date. Male, small bee fly, same date. Female, small pyralid moth, Oct. 12, College Station (F. F. B.).

124. **Erax bicaudatus** Hine. Ann. Ent. Soc. Amer., 12 (2): 138 (1919). Amarillo, Sept. 28–Oct. 10, 1931 (S. E. Jones). Plainview, Oct. 1, 1931 (S. E. Jones). Hereford, Oct. 4, 1931 (S. E. Jones). Coyote L., Bailey Co., Aug. 25, 1921 (C. D. Duncan) (Cole).

125. **Erax interruptus** Macquart. Hist. Nat. des Dipt., 1: 310 (1834). A common species in fields, pastures, around farm buildings and gardens, where it rests on the ground, flying up with a sharp buzz and usually alighting only a short distance away. Feeds largely on grasshoppers, frequently seizing individuals larger than itself. Brazos, Burleson, Madison, Kendall, Bexar, Cameron, Hidalgo, Webb, Pecos, Brewster Counties, May 1–Oct. 19.

Prey.—Diptera. Male, bee fly (*Anthrax lucifer*), July 8. Female, screwworm fly (*Cochlyomyia macellaria*) Aug. 27. Female, tachinid fly, *Phorocera claripennis* Macq. (Det. H. J. Reinhard), July 30. Female, female asilid, *Proctacanthella cacopiloga*, Aug. 11.

Orthoptera. Grasshopper, *Syrbula admirabilis* Uhler. Madison Co., Aug. 16, 1932 (Bibby & O'Dowd). Female, grasshopper, *Mestobregma fuscifrons* Stal. (Det. V. A. Little), Aug. 8, 1932. Male, grasshopper, Aug. 4, 1930 (Bibby & O'Dowd). Male, grasshopper, July 20, 1931 (Bibby & Tate). Female, small *Melanoplus*, June 16. Female, small *Melanoplus*, June 26. Female, small grasshopper, Midway, June 28. Female, small grasshopper, July 30. Female, small grasshopper, Midway, Aug. 3. Female, Ibid. Female, Ibid., Aug. 8. Female, Ibid., Aug. 17. Male, small grasshopper, *Tettix* sp., Aug. 4. Female, grasshopper, *Syrbula admirabilis*, Aug. 4 (Det. V. A. Little).

Hemiptera. Male, leafhopper, *Draeculacephala reticulata* Sig., July, 1932 (H. J. R.).

126. **Erax bexarensis** n. sp. Bexar Co., June 14–July 5 (H. B. P.). Carrizo Springs, June 10, 1928 (W. A. Frazier). Laredo, May 18, 1922. Metz, June 16, "one male with a blue lycaenid butterfly as prey." (R. H. P.).

127. **Erax texanus** Banks. Ann. Ent. Soc. Amer., 12 (2): 151 (1919). Abundant in the southwestern part of the state. Most of the specimens recorded below were collected in bee yards by S. E. McGregor, who found them feeding extensively on honey bees. Bexar, Uvalde, Jim Hogg, Brooks, Hidalgo, Starr, Webb, La Salle, Dimmit, Frio, Kendall, Pecos, Kimble, Eastland Counties, July 18–Aug. 18. According to Mr. McGregor, *E. texanus* is not a ground-inhabiting species, but usually rests on dead twigs, sticks, rocks, or the bare branches of small shrubs or brush.

Prey.—Hymenoptera. Female, worker honey bee, Hebbronville, Aug. 18, 1932 (S. E. McG.). Female, Ibid. Female, Ibid. Female, Ibid. Female, Ibid., Uvalde Co., Sept. 12, 1932 (S. E. McG.). Male, Ibid.

Lepidoptera. Male, small moth, Hebbronville, Aug. 18, 1932 (S. E. McG.). Female, Ibid. Female, small butterfly, Pearsall, Sept. 4, 1932 (S. E. McG.). Male, small butterfly, Uvalde Co., Sept. 12, 1932 (S. E. McG.).

Hemiptera. Male, assassin bug, *Apiomerus spissipes*, Uvalde Co., Sept. 12, 1932 (S. E. McG.). Male, coreid bug, Ibid. Male, small Hemipteron, Ibid.

128. **Erax aurivestitus** Hine. Ann. Ent. Soc. Amer., 12 (2): 142 (1919). Unlabeled specimen (U. T.).

129. **Erax argentifrons** Hine. Ohio Natur., 11: 308 (1911). Austin, May (U. T.). Marathon, July 1–2, 1916 (Lutz—A. M. N. H.). "Bastrop, May 9, 1921, in pine region; Bastrop and Austin, 42 specimens, March 3–May 30" (R. H. P.). Bexar Co., May 1, 1929 (H. B. P.).

130. **Erax argyrosoma** Hine. Ohio Natur., 11: 310 (1911). Austin, March 12–May, 1932 (U. T.). Trans-Pecos, 1916, F. M. Gaige (Hine). Davis Mts., Fort Davis Quad, Phantom Lake, June 1, 1916 (F. M. Gaige) (Hine). El Paso, July 1 (Duncan) (Cole). Orla, Aug. 5, 1931; Junction, Aug. 15; Chisos Mts., July 8, 1930 (H. M. Smith); Erwin, Aug. 4, 1931 (R. H. P.).

131. **Erax pilosus** Hine. Annals Ent. Soc. Amer., 12 (2): 150 (1919). El Paso, June (A. N. S. P.).

132. **Erax auripilus** Hine. Ohio Jour. Sci., 17: 22 (1916). (Pl. I, Fig. 4). Mr. Parks informs me that this early spring species frequently feeds on honey bees. Taylor, May 23, 1929 (J. C. Gaines). Pampa, June 13, 1930. Bexar Co., April (H. B. P.). "Dallas" (A. M. N. H.). Austin, April, May (U. T.). Bexar Co., June 25, 1928 (H. B. P.). Round Mt. (A. N. S. P.).

Prey. Female, small spider wasp, April 20, 1932, Bexar Co. (H. B. P.).

133. **Erax plenus** Hine. Idem, 21. This large robust species appears to be rather uncommon. The only specimen I have seen was in a grassy area along a roadway. June to August. "Dallas" (A. M. N. H.). Austin, May (U. T.). "Austin, May 30; Brady, July" (R. H. P.). Waco, July 24, 1932 (S. W. B.).

Prey. Female, small grasshopper, June 23, 1932 (J. C. Gaines).

134. **Erax prairiensis** n. sp. Prairie View, June 8, 1932 (S. W. B.); and June 18, 1933 (H. J. R. & R. K. F.).

135. **Erax nemoralis** Hine. Ohio Natur., 11: 311 (1911). Quite common in the Trinity River bottoms. An active species, flying with a shrill buzz. Madison Co., June 21, 1931 (Bibby & Tate). Stafford, May 3, 1929. Iowa Park, May 30, 1932 (S. E. Jones).

Prey. Female, fulgorid, June 28, 1932. Female, medium-sized pentatomid, June 28, 1932.

136. **Erax belfragei** Hine. Ann. Ent. Soc. Amer., 12 (2): 121 (1919). Milano, April 28, 1929. Austin, May 15, 1931 (U. T.).

137. **Erax aestuans** Linnaeus. Systema Naturae, 12th edition, 2: 1007, 5 (1767). This widely distributed species is very common in eastern Texas. Frequently alights on buildings, as well as trees, thickets, posts, and fences; often feeds on house flies. *E. aestuans* has the peculiar habit of alighting on moving objects, such as cattle or even human beings. It is therefore one of the most familiar and readily recognized species. Brazos, Burleson, Madison, Bexar, Travis, Frio, Wilson, Milan, Brown, Kleberg, Tarrant Counties, May 2–Oct. 10.

Prey.—Hymenoptera. Male, worker honey bee, July 3. Female, harvester ant (*Pogonomyrmex barbatum*), June 11.

Diptera. Male, house fly (*Musca domestica*), June 1. Male, Ibid., July 11. Female, Ibid., July 8. Female, Ibid., July 14. Female, Ibid., July 4. Female, asilid fly, *Atomosia punctifera*, June 27, 1925, Austin (R. H. P.). Female, asilid fly (*Atomosia puella*), June 14. Female, dolichopodid fly, *Psilopus sipho*, June 20. Male, deer fly (*Chrysops flavidus*) July 4. Female, deer fly (*Chrysops callidus*), July 4.

Lepidoptera. Female, small moth, June 11.

Hemiptera. Male, small tree hopper, July 12.

138. **Erax apicalis** Wiedemann. Diptera Exotica, 191, 16 (1821). A small species suggesting a miniature *E. aestuans*. Occurs in sandy fields, alighting on the short, scattered weed stalks. August.

Prey.—Male, a bee fly (*Anthrax* sp.), Aug. 14, 1932 (H. J. R.).

139. **Erax kansensis** Hine. Ann. Ent. Soc. Amer., 12 (2): 122 (1919). DeLeon, June 28, 1931. Austin, May (U. T.). Austin, June–July (R. H. P.).

140. **Erax mexicanus** Hine. Ann. Ent. Soc. Amer., 12 (2): 123 (1919). Bexar Co., June 15, 1929 (H. B. P.) (J. Wilcox).

141. **Erax cressoni** Hine. Ann. Ent. Soc. Amer., 12 (2): 134 (1919). El Paso, March (A. N. S. P.).

142. **Erax snowii** Hine. Ann. Ent. Soc. Amer., 12 (2): 116 (1919). Mills, Bexar, Frio, Travis, Jim Hogg Counties, Feb. 18–June.

143. **Erax prattii** Hine. Ann. Ent. Soc. Amer., 12 (2): 117 (1919). Laredo, Nov. 25, 1905, collected by F. C. Pratt (Hine). Bexar Co., 28, May 1929 (H. B. P.).

144. **Erax tuberculatus** Coquillett. Jour. N. Y. Ent. Soc., 12: 34 (1904). Mr. McGregor found this species in bee yards in the southwestern part of the

state, but it is apparently too small to be a successful bee-catcher. Bexar, Wilson, Kleberg, Hidalgo, Starr, Brooks, Cameron, Pecos, Brewster, Travis, Tom Green, Brown, Webb, Dimmit Counties, June 22–Sept. 13.

145. **Erax leucocomus** Williston. Trans. Amer. Ent. Soc., 12 (2): 69 (1885). "Dallas, Sept. 5, 1905, collected by F. C. Bishopp" (Hine). One male, Goldthwaite, May 29, 1933 (S. E. McG.).

146. **Erax barbatus** Fabricius. Systema Antliatorum, 169 (1805). A widespread species occurring in sandy fields, along dried water courses and similar locations. Brazos, Burleson, Madison, Galveston, Travis, Mills, Jeff Davis, Pecos, Brown, Crockett, Brewster, Bexar, Hidalgo, Cameron Counties, May 28–Oct. 20.

Prey.—Male, asilid fly, *Stichopogon trifasciatus*, July 30, 1932. Male, screw-worm fly (*Cochliomyia macellaria*), Aug. 11. Male, sarcophagid fly, July 31, 1932, Warda.

147. **Erax armatus** Hine. Annals Ent. Soc. Amer., 12 (2): 112 (1919). "Davis Mountains, collected by F. M. Gaige, Cotulla (F. C. Pratt) and Uvalde" (Hine), June and July. Bexar Co., June 16, 1929 (H. B. P.) (Wilcox). Bexar Co., July 5, 1932 (H. B. P.).

148. **Erax tagax** Williston. Trans. Amer. Ent. Soc., 12: 65 (1885). Livermore Park, Davis Mts., July 9 (Duncan) (Cole).

149. **Erax bicolor** Ballardi. Sagg. di Ditt. Mess. 2: 47 (1861). Big Bend Region, summer, 1928 (F. F. Bibby). Presidio, June 26, 1928 (F. L. Thomas). McMullen Co., July 12, 1932, in apiary (S. E. McG.). "Kingsville, July, collected by F. M. Hull" (R. H. P.). Bexar Co., June 7–12, 1929 (H. B. P.) (J. Wilcox). Brownsville, Aug. 3, 1921 (C. D. Duncan) (F. R. Cole).

150. **Erax grandis** Hine. Annals Ent. Soc. Amer., 13: 111 (1919). (Pl. II, Fig. 9). Weslaco, May 25, 1930 (J. C. Gaines). Hidalgo Co., May 26, 1930 (J. C. Gaines). Bexar Co., June 25, 1930 (H. B. Parks). Brownwood, Aug. 22, collected by F. M. Hull; Mason, July 28, Aug. 23 (R. H. P.). Round Mountain (A. N. S. P.). Pecos R., Sheffield, July 23 (Duncan); 11 miles northwest of Sanderson, July 21 (Duncan) (Cole). *E. grandis*, *bicolor* and *armatus* occur in mesquite groves, resting on twigs or trees and resemble, in habits and appearance, large *E. aestuans*.

151. **Asilus sericeus** Say. Jour. Acad. Sci. Phila., 3: 48 (1823). "Texas" (M. A. E. S. C.).

152. **Asilus gracilis** Wiedemann. Auss. Zweifl. Ins., 1: 445 (1828). "Texas" (Hine). Colorado, Aug. 10, 1910 (A. M. N. H.). Austin, May 16, 1931 (U. T.). "Two males, June 1; 3 females, May–June, Austin, as prey of one of the males, a tachinid fly" (R. H. P.). "Trans-Pecos" (Hine).

153. **Asilus compositus** Hine. Ohio Jour. Sci., 18 (8): 321 (1918). Occurs in shady thickets along water courses, alighting on dead twigs. May 25–July 4. Kerrville (F. C. Pratt) (J. S. Hine).

Prey.—Female, the tachinid, *Xanthomelana arcuata* (H. J. R.).

154. **Asilus notatus** Wiedemann. Auss. Zweifl. Ins., I, 451 (1828). An early spring species, occurring in the post oak woods, April 7–May 26 (H. J. R.).

155. **Asilus rubicundus** Hine. Annals Ent. Soc. Amer., 2: 162 (1909). A common late spring species occurring in dry fields and flying with a high-pitched, wispy buzz. May 29–June 19. May 22, 1932, numerous specimens (H. J. R.). Brownwood, June 29; Austin, April and May, "slightly larger than described size" (R. H. P.). Mills Co., July 20, 1931; Brownwood, June 29, 1921; Austin, May 30, 1921 (R. H. P.).

156. **Asilus prairiensis** Tucker. Kans. Univ. Sci. Bull., 4: 93 (1908). A common species. Oct. 12–26. Plainview, Oct. 1, 1931; Oct. 18, 1930 (S. E. Jones). Amarillo, Sept. 28, 1930 (S. E. Jones). Hereford, Sept. 26, 1930 (S. E. Jones).

157. **Asilus paropus** Walker. List of the Diptera of the British Museum, 2: 455 (1879). College Station, Oct. 17–Nov. 7.

158. **Proctacanthella leucopogon** Williston. Kans. Univ. Quart., 2: 75 (1893). In habits, similar to *cacopiloga*. Many of the following have the upper forceps shorter than in typical *leucopogon* and may prove to be distinct. Several specimens, Sept. 1, 1932, Bexar Co. (H. B. P.). Brownwood, June 24–July 18 (R. H. P.). "Trans-Pecos" (Hine). Port Lavaca, July 25–Aug. 21, 1925 (R. H. P.). Bexar Co., June 31, 1928 (H. B. P.).

159. **Proctacanthella cacopiloga** Hine. Ann. Ent. Soc. Amer., 2: 166 (1909). (Pl. I, Fig. 3). One of the most abundant Texas Asilids occurring throughout the summer on sandy areas, paths, cotton fields, and other cultivated grounds. With colors harmonizing with the ground on which it alights, *P. cacopiloga* is difficult to see, its presence usually first betrayed by its sharp buzz. Its actions and appearance are very suggestive of a miniature *Erax interruptus*. Feeds on leafhoppers, small diptera, etc., and frequently falls prey to larger and stronger Asilids. Brazos, Burleson, Madison, Kendall, Bexar, Dickens, Travis, El Paso, Kleberg, Tom Green, Bailey, McCulloch Counties, May 24–Oct. 28. Brownwood, "a peculiar deformity in one male, the antennae surmounted by 5 or 6 styles" (R. H. P.).

Prey.—Diptera. Female, house fly, *Musca domestica*, June 30. Female, Ibid., June 12. Female, sarcophagid, *Senotainia trilineata* Wulp., Aug. 30, (Det. H. J. R.). Female, asilid, *Psilocurus nudiusculus* Loew, Aug. 18.

Hymenoptera. Female, small sweat-bee, *Halictus* sp., Aug. 18. Female, small sweat-bee, *Halictus* sp., Aug. 21. Male, Ibid., Aug. 21.

Hemiptera. Female, chinch-bug, *Blissus leucopterus*, June 16. Female, leafhopper, *Draeculacephala reticulata* Sig. (Det. R. K. Fletcher), July 27. Female, Ibid., Aug. 16. Female, Ibid., Aug. 17. Female, Ibid., Aug. 18. Female, Ibid., Aug. 18. Male, Ibid., Aug. 18.

160. **Philonicus limpidipennis** Hine. Ann. Ent. Soc. Amer., 2: 167 (1909). Fort Davis, July (A. N. S. P.).

161. **Philonicus truquii** Bellardi. Sagg. di Ditt. Mess., 2: 52 (1861). College Station, May 21, 1923 (H. J. R.).

EXPLANATION OF PLATES

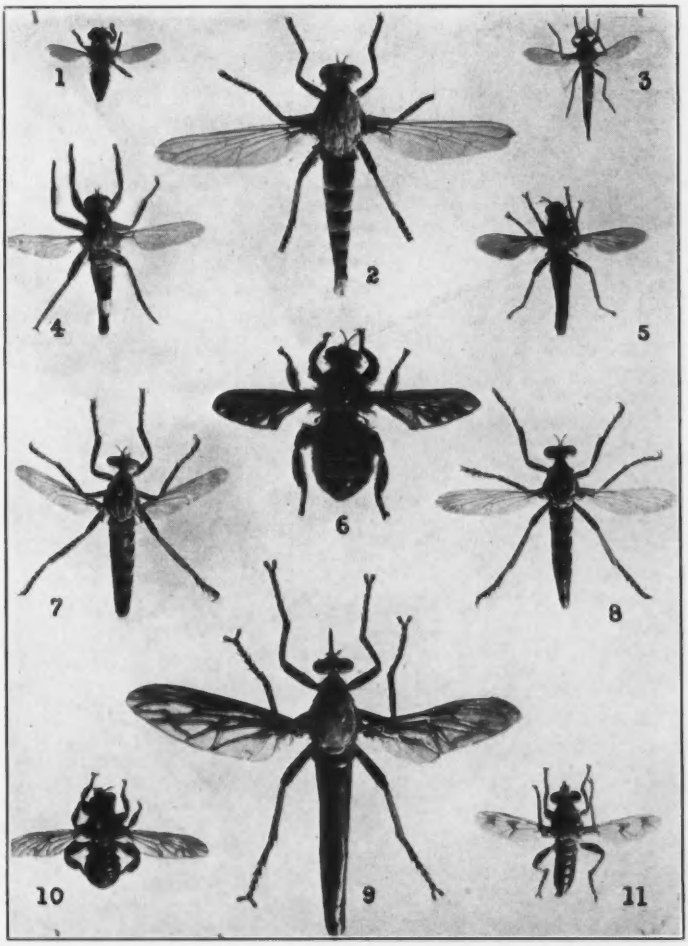
(All figures natural size.)

Plate I

1. *Mallophora acra* Curran. Male. (List No. 97).
2. *Promachus giganteus* Hine. Male. (No. 111).
3. *Proctacanthella (Asilus) cacopiloga* Hine. Female. (No. 159).
4. *Erax auripilus* Hine. Male. (No. 132).
5. *Stenopogon latipennis* Loew. Male. (No. 23).
6. *Bombomima (Dasyllis) macquartii* (Banks). Female. (No. 89).
7. *Diogmites (Deromyia) angustipennis* Loew. Female. (No. 59).
8. *Diogmites (Deromyia) symmachus* Loew. Female. (No. 60).
9. *Microstylum morosum* Loew. Female. (No. 30).
10. *Bombomima (Dasyllis) flavicollis* (Say). Female. (No. 87).
11. *Andrenosoma (Nusa) rubidum* (Williston). Male. (No. 94).

Plate II

1. *Proctacanthus milbertii* Macquart. Male. (No. 117).
2. *Lampria bicolor* (Wiedemann). Female. (No. 91).
3. *Proctacanthus longus* (Wiedemann). Female. (No. 116).
4. *Microstylum galactodes* Loew. Male. (No. 29).
5. *Saropogon dispar* Coquillett. Male. (No. 54).
6. *Dizonias tristis* (Walker). Male. (No. 28).
7. *Promachus texanus* n. sp. Male. (No. 108).
8. *Promachus hinei* Bromley. Male. (No. 112).
9. *Erax grandis* Hine. Male. (No. 150).
10. *Mallophora orcina* (Wiedemann). Male. (No. 99).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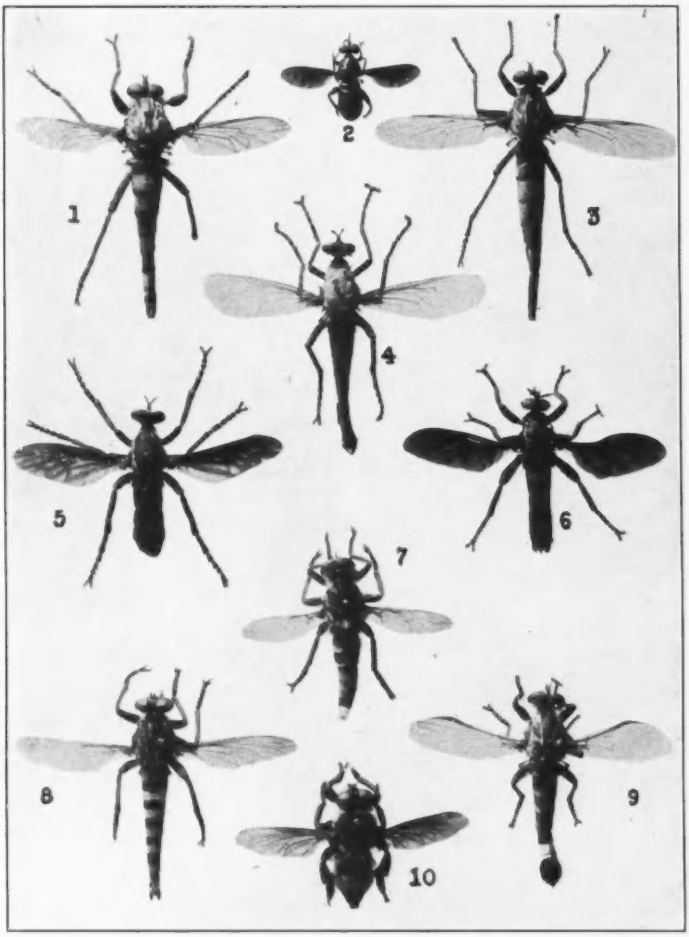
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BOOK NOTICES

RECENT ADVANCES IN THE STUDY OF PLANT VIRUSES, by KENNETH M. SMITH, with Foreword by F. T. BROOKS. Pages i–xii and 1–428. One colored plate and 67 text-figures, mostly from photographs. 1934. Published by P. Blakiston's Son and Co., Inc., 1012 Walnut Street, Philadelphia. Price, $4.00 net.

This volume is one of the series on "Recent Advances" in various biological sciences published by Blakiston. It is uniform in its dark blue cloth binding with the volume familiar to all entomologists, "Recent Advances in Entomology," by A. D. Imms. It is larger than the Imms volume by fifty pages and printed on heavier paper to take the numerous halftones. It contains the following chapters and parts: Chapter I, Introductory; II, Symptomatology; III–IV, Physical Properties (of viruses); V–VII, Insects in Relation to Viruses; VIII, Transmission and Spread of Plant Viruses; IX, Physiology of Virus Diseases; X–XI, Some Further Aspects of the Study of Plant Viruses; XII, Potato Virus Diseases and Viruses; XIII–XIV, The Virus Diseases of Plants; and glossary of Terms, Index to Authors, and General Index.

This is a very live subject in the entomological world because these diseases are usually spread from plant to plant by insects. The ultimate solution of plant virus problems will probably be by the development of resistant and eventually perhaps immune strains of crop plants. In the meantime the entomologist is vitally concerned. Chapters V to VII are wholly devoted to the role insects play in transmission, while Chapter VIII is largely concerned with parallel problems. Chapter V is devoted to insectary methods with a bibliography of fifty references. Chapter VI discusses the relationship of the virus to the insect under such heads as (a) incubation period of virus in the insect, (b) specificity of insect for a particular virus, (c) selective transmission from a complex of viruses, and (d) longevity of virus in the body of the insect vector. Fifty references are given. Chapter VII covers some relationships between the plant and the insect vector, such as: effect of insect's saliva on plant, what tissues are penetrated by the mouth-parts of the insect, etc., with a list of forty-eight references. Chapter VIII covers types of transmission, more particularly by other means than insects, such as by grafting, by inoculation, by seed, by pollen, by various rough contacts, etc., with seventy-nine references, items which have to be checked off in the study of insects in relation to the disease.

This review of the subject of plant viruses is comprehensive and is apparently conservative in its conclusions and comments. Its high quality is confirmed by Professor D. M. DeLong and other friends of the writer who are doing research in this field. As recently stated by Professor H. W. Stunkard, there are probably more parasitic organisms than all other species of animals. This volume covers one phase of the long series of problems in the general field of the biology of parasitism and will be found interesting by all students in the biological sciences.

—C. H. K.

TERMITES AND TERMITE CONTROL, Edited by CHARLES A. KOFOID, S. F. LIGHT, A. C. HOMER, MERLE RANDALL, W. B. HERMS AND EARL E. BOWE. Pages i–xxv and 1–734; 182 text figures, 82 tables. 1934. Published by the University of California Press, Berkeley, Calif. Price, $5.00.

This volume is large enough to hide behind when some wild-eyed friend bursts into our office and fairly shouts that the dining room floor has caved in and the joists are eaten out by white bugs. "What can I do?" Questioning usually reveals that the friend hopes the entomologist can suggest fifty cents worth of an insecticide that will exterminate the termites and at the same time restore the floor to its former condition. The ignorance of the householder and the indifference of builders to termite destructiveness is appalling. In Ohio alone damage by termites probably runs over a million dollars annually. Because of the secretive habits of termites the damage is usually extensive before it is recognized. This volume will be a great help to all those on whom falls the burden of educating the public in these matters.

The present publication is the report of "The Termite Investigations Committee," a Pacific Coast co-operative group, composed of leaders in the lumber and building trades, the railroads, Chambers of Commerce, and specialists largely drawn from the biological and engineering staffs of the University of California.

Its investigations covering a period of several years and an expense of over $50,000 were supported by subscriptions from the various business interests burdened with termite damage. Fourteen subcommittees were appointed, each assigned some limited phase of the problem. The book is composed of the fifty-six reports of the subcommittees and the experts employed by them. The Executive Committee correlated the various reports, but these are made on the responsibility of the subcommittees themselves except "No. 46, General Recommendations," which section was approved by the Executive Committee. Thus the written report is a compilation of the writings of thirty-five authors, each of whom is given credit for the chapter or chapters from his pen.

The report is divided into four parts: Part I, Termites and Their Biology, Chapters 1–32, pages 1–338; Part II, Chemical Investigations, Chapters 33–40, pages 339–486; Part III, Termite Resistivity of Wood and Building Materials, Chapters 41–45, pages 487–538; and Part IV, Prevention and Repair of Termite Damage, Chapters 46–56, pages 539–725. The volume concludes with a bibliography of nine pages. There is no index, but this function is taken care of by a very elaborate table of contents covering fifteen pages. Thus one-half of the report is devoted to economic problems which will make it the final authority in the field of applied science for years to come.

It is without doubt the outstanding entomological publication of the past several years and will supersede the termite report of the Belgian Government, "Les Termites," 1922, by E. Hegh, which in its day received high appreciation. We regret that lack of space prevents us from saying the appreciative things we would like to say concerning the individual chapters that interest us most. The Report marks a distinct advance towards the solution of the termite problem and is a credit to the Committee.—C. H. K.

BUMBLES AND THEIR WAYS, by Otto Emil Plath. Pages i–xvi and 1–201. Colored frontispiece, 20 figures and 10 plates. Published by the Macmillan Company, 60 Fifth Ave., New York. Price, $4.00.

"Bumbles and Their Ways," while from the pen of an authority and thoroughly scientific, is written in a discursive popular style which makes it a very interesting and readable volume. Opening with a foreword by Professor Wheeler, the work is divided into the following chapters: I, Founding a Colony; II, Colony in Midsummer; III, Climax in Development of the Colony; IV–V, Psithyrus, the "Cuckoo" Bumblebee; VI, Commensals, Parasites and Predators; VII, Protection and Defense; VIII, The "Trumpeter;" IX, Hibernation; X, Colonies in Artificial Nests; XI, Finding and Transferring Colonies; XII, Economic Importance, and XIII, Classification Based on Behavior. Following Chapter XIII is given an appendix of forty pages which takes up individually all the common species of bumblebees of the North-east United States with maps showing their distribution. The book closes with a bibliography of seventeen pages and a detailed index of six pages. Dr. Plath is above all a field naturalist and has spent the greater part of his research time in the field or in observing nests of bumblebees transferred in boxes to his rooms. The volume is an intimate record of the goings and comings and doings of these very interesting social insects. His research has cleared up many puzzling questions giving us clear explanations of such curious habits as that of the "trumpeter," which some earlier students of bumblebees thought was a worker whose individual duty was to mount the nest at dawn and awaken the colony by buzzing. Chapters IV and V on the parasitic bumblebees of the genus Psithyrus give the reader a picture of Plath's methods and a measure of the amount of interesting information he has accumulated during the twelve years he has been studying New England bumblebees.

The book is artistically printed on a thick, soft paper with well spaced type. To the writer, interested in social insects, it is one of the most attractive volumes he has read in several months. We recommend it for all entomological libraries.

—C. H. K.

PROCEEDINGS OF THE TWENTY-EIGHTH ANNUAL MEETING.

Boston, Massachusetts, December 28th and 29th, 1933.

The Entomological Society of America held its Twenty-eighth Annual Meeting on Thursday and Friday, December 28 and 29, 1933. Thirty-five papers dealing with various fields of entomological research were presented. Professor Nathan Banks, of Harvard University, whose paper opened the meetings, gave an interesting history of the entomological work of the Museum of Comparative Zoology.

The Annual Public Address was given by Doctor Frank E. Lutz, of the American Museum of Natural History, New York. This address followed the Entomologists' Dinner and was entitled, "What's the Use?" After asking this question concerning many activities of man, especially of entomologists, the speaker proceeded to ask the same question concerning certain existing facts of nature relating to the insects and their relatives. For example, it has been stated that certain yellow crab spiders await their prey in yellow flowers. To the human eye the spiders are inconspicuous and have been assumed to be the same to the insect flower visitors upon which the spiders feed. Recent research has shown, however, that the flowers have ultra-violet patterns while the spiders do not. Insects on the other hand can perceive ultra-violet, which should make the spider conspicuous—so, "What's the Use?" During the past summer Doctor Lutz studied the response of certain flies to 2,537 angstroms radiation. These waves are shorter than ultra-violet of sun light which can reach the earth's surface and so do not occur in nature. Nevertheless the flies responded positively to such stimuli, but, "What's the Use?"

An interesting Symposium on Biological Control was given by C. P. Claussen, D. M. Daniel, B. B. Pepper and B. F. Driggers, J. V. Schaffner and P. B. Dowden. Unfortunately, Doctor Alvah Peterson, who planned the Symposium, was unable to be present.

Opening Session, Thursday Morning, December 28.

The Society was called to order at 9:30 A. M., by PRESIDENT R. E. SNODGRASS, in East Room, Austin Hall, Harvard University. The following papers were presented:

1. Entomology at the Museum of Comparative Zoology. NATHAN BANKS, Harvard University.
2. Wing Dimorphism of some North American Carabid Beetles. (Lantern.) P. J. DARLINGTON, JR., Harvard University.
3. The Homopterous Head. (Lantern.) Z. P. METCALF, North Carolina State College.
4. The Metasternal Gland of Ants. (Lantern.) GEORGE S. TULLOCH, Brooklyn College, Brooklyn, New York.
5. A Study of the North American Species of Balclutha and Agellus (Homoptera, Cicadellidae). (Lantern.) D. M. DELONG AND R. H. DAVIDSON, Ohio State University.

6. Prothetely in *Epilachna corrupta* Muls. (Coleoptera). (Lantern.) B. J. LANDIS AND R. H. DAVIDSON, Ohio State University.
7. Notes on North American Trypetidae (Diptera), No. 1. (Lantern.) F. S. BLANTON, U. S. Ent. Lab., Babylon, L. I., N. Y.
8. Notes on Some Uncommon Crane-flies from Mt. Washington, New Hampshire. C. P. ALEXANDER, Massachusetts Agricultural College.
9. Additions to the Neuroptera of Kansas. (By Title.) ROGER C. SMITH, Kansas State College, Manhattan.
10. The Significance of the Dragonfly Name "Odonata." CLARENCE E. MICKEL, University of Minnesota.
11. Some Basic Principles of Insect Wing Venation. (Lantern.) J. G. NEEDHAM, Cornell University.

The following committees were appointed by PRESIDENT SNODGRASS:

Nominating Committee—GEO. A. DEAN, Chairman; P. P. CALVERT, C. R. CROSBY.

Auditing Committee—HOWARD O. DEAY, Chairman; D. M. DELONG, P. A. READIO.

Second Session, Thursday Afternoon, December 28.

The Society was called to order by PRESIDENT SNODGRASS at 1:30 P. M., East Room, Austin Hall, Harvard University. The following Symposium was presented: "Biological Control."

(a) The Utilization of Native Parasites and Predators in Biological Control. C. P. CLAUSSEN, Washington, D. C.
(b) Methods and Results of an Experiment in Biological Control. D. M. DANIEL, Geneva, N. Y.
(c) Non-economic Insects as Intermediate Hosts of Parasites of Economic Insects: Oriental Fruit Moth. B. B. PEPPER AND B. F. DRIGGERS, New Brunswick, N. J.
(d) Rearing of Native Larvae for the Recovery of Introduced Parasites. J. V. SCHAFFNER, JR., Melrose Highlands, Mass.
(e) Recently Introduced Parasites of Three Important Forest Insects. P. B. DOWDEN, Melrose Highlands, Mass.
(f) Biological Control Courses and Investigations in our Universities. ALVAH PETERSON, Ohio State University.

12. Preliminary Notes on the Technique of Mass Production of Beneficial Syrphid Flies, (Diptera, Syrphidae). (By Title.) CHAS. L. FLUKE, JR., University of Wisconsin.
13. Observations on the Biology of *Microbracon pygmaeus* (Prov.) an Important Parasite of *Coleoptera pruniella* Cl. MELVIN H. DONER, University of Wisconsin.
14. Hyperparasitism in the Case of Some Introduced Lepidopterous Tree Defoliators. (Reflectoscope.) A. B. PROPER, Melrose Highlands, Mass.
15. Remarks on the Insect Fauna of Bermuda. HERBERT OSBORN, Ohio State University.
16. Supplementary Report on the Mosquito Survey of Maryland. F. C. BISHOPP, U. S. Bureau of Entomology, Washington, D. C.; ERNEST N. CORY, College Park, Maryland; and ALAN STONE, U. S. Bureau of Entomology, Washington, D. C.

PRESIDENT SNODGRASS appointed P. P. CALVERT to act as alternate for J. M. SWAINE on the Executive Committee, which met immediately following the afternoon session.

Third Session, Thursday Evening, December 28.

The Society was called to order by PRESIDENT SNODGRASS at 8:15 P. M., in the Ballroom, Bradford Hotel, following the Entomologists' Dinner. The President then introduced FRANK E. LUTZ, who gave the Annual Public Address which was entitled "What's the Use?"

Fourth Session, Friday Morning, December 29.

The Society was called to order by PRESIDENT SNODGRASS. The following papers were presented:

17. Notes on Distribution and Biology of *Brunneria borealis* Scudd. (Mantidae). (By Title.) O. W. ROSEWALL, Louisiana State University.
18. Lemna Insects. (Lantern.) MINNIE B. SCOTLAND, New York State College.
19. Observations on the Biology of *Phaedon viridis* Melsch., the Water Cress Beetle. (By Title.) PAUL E. HERING, Cornell University.
20. A Comparison of the Oxygen Consumption of a Swift Water and a Pond Species of Caddisfly Larva. (Lantern.) HELEN D. O'NEILL, Mt. Holyoke College, South Hadley, Mass.
21. The Generations of the Dragonfly, *Annax junius*. (Chart.) P. P. CALVERT, University of Pennsylvania.
22. Ancestral Development of Insects as Indicated by Molting in Thysanura. HARVEY L. SWEETMAN, Massachusetts State College.
23. Cornus as a Host for Fruit Flies of the Genus Rhagoletis. (Lantern). HUGH GLASGOW, New York Agricultural Experiment Station.
24. The Strength of Saturniid Larvae. (Lantern.) J. A. MANTER, Connecticut Agricultural College.
25. Observations on Oviposition in *Papaipema purpurifascia* G. & R. and *Macronoctua onusta* Grt. (Lepidoptera, Noctuidae). (Lantern.) GRACE H. GRISWOLD, Cornell University.
26. Some Observations on the Effects of Radio Waves on Insects and Plant Hosts. (Lantern.) THOMAS J. HEADLEE, New Jersey Agricultural Experiment Station.
27. Growth and Determinate Size in Insects. (Lantern.) C. T. BRUES, Harvard University.
28. Some Phases of Growth in Insects. (Lantern.) NELLIE M. PAYNE, University of Minnesota.

Fifth Session, Friday Afternoon. December 29.

29. The Effects of Temperature and Humidity on the Egg, Larval and Adult Stages of the Bean Weevil, *Bruchus obtectus* Say. (Lantern.) HENRY MENUSAN, JR., Cornell University.
30. The Nesting Habits of Isodontia. (Lantern.) RICHARD DOW, Harvard University.
31. The Use of the Cockroach, *Blattella germanica*, as a Test Animal for Vitamin B. Fractions and for the Quality of Proteins. (Lantern.) C. M. MCCAY, Cornell University.
32. Protein and Amino Acid Requirement of the Cockroach. (Lantern.) LAWRENCE C. WOODRUFF, Cornell University.
33. Correlations of Milliped and Gnat Feeding with Potato Scab Organisms. (Lantern.) G. F. MACLEOD, Cornell University.
34. Nature and Function of Fungus Associates of Insect Galls. (Lantern.) K. D. DOAK, University of Pennsylvania.
35. The Internal Morphology of the Common Red Spider Mite. (Lantern.) WM. E. BLAUVELT, Cornell University.

The above meetings were attended by about 150.

The Annual Business Meeting followed:

REPORT OF THE SECRETARY.

During the year 1933, the following, having been duly nominated and recommended, were elected members of the Society by mail ballot of the Executive Committee:

E. GORDON ALEXANDER, University of Colorado, Boulder, Colo.
KENNETH D. ARBUTHNOT, 451 Godfrey Ave., Monroe, Mich.
WM. A. BAKER, 2949 Portsmouth St., Toledo, Ohio.
A. M. BOYCE, Citrus Experiment Station, Riverside, Calif.
LAWRENCE C. HARPER, Fort Jackson, New York.

HOWARD H. HILLEMANN, 1205 W. Johnson St., Madison, Wis.
FRANK G. HINMAN, 140 N. 25th St., Corvallis, Oregon.
HUBERT C. MANTIS, Montana State College, Bozeman, Mont.
HENRY E. PARISH, Box 487, Menard, Texas.
PAUL E. RITCHER, University of Wisconsin, Madison, Wis.
FIDEL DEL ROSARIO, care The Rockefeller Foundation, 61 Broadway, New York, N. Y.

With the approval of the Executive Committee, FRANK E. LUTZ was invited to give the Annual Public Address of the Society at the Boston meeting.

MR. C. W. COLLINS kindly consented to act as chairman of the Arrangements Committee for the Boston meeting. The other two members of the committee were W. D. WHITCOMB and C. T. BRUES.

Under authority of the Society at its New Orleans meeting, PRESIDENT SNODGRASS reappointed the following to serve on the Membership Committee: D. M. DELONG, Chairman; E. O. ESSIG, ROGER C. SMITH, J. MCDUNNOUGH, J. S. WADE, O. I. SNAPP and HENRY BIRD. J. A. MANTER was later appointed as alternate for HENRY BIRD.

The committee on International Organization of Zoologists appointed by PRESIDENT DAVIS and consisting of the following was requested to bring in a report: J. C. BRADLEY, Chairman; C. P. ALEXANDER, G. F. FERRIS, HAROLD MORRISON and J. M. SWAINE.

The Executive Committee met at 4:30 P. M., December 28, in Bradford Hotel, Boston, Mass., the following officers being present: R. E. SNODGRASS, H. B. HUNGERFORD, C. H. KENNEDY. Other members of the committee present were: R. C. OSBURN, W. T. M. FORBES, A. L. MELANDER, EDITH M. PATCH, F. C. BISHOPP, and P. P. CALVERT, as alternate designated by the President to serve in the place of J. M. SWAINE, who was absent.

The following were elected to membership in the Society:

MARY AUTEN, Agnes Scott College, Decatur, Georgia.
A. AVINOFF, Carnegie Museum, Pittsburgh, Pa.
M. S. BRISCOE, Storer College, Harpers Ferry, W. Va.
F. MARTIN BROWN, Fountain Valley School, Colorado Springs, Colo.
ELIZABETH B. BRYANT, Museum Comparative Zoology, Cambridge, Mass.
RALPH J. BUSHNELL, 1724 Regent St., Madison, Wis.
FRANK M. CARPENTER, Museum Comparative Zoology, Cambridge, Mass.
JOHN T. CREIGHTON, University of Florida, Gainesville, Fla.
R. W. DEAN, Box 51, Vassar College, Poughkeepsie, N. Y.
L. C. GLOVER, Box 486, T. Hall, Durham, N. H.
ASHLEY B. GURNEY, Massachusetts State College, Amherst, Mass.
HOWARD E. HINTON, 1971 El Dorado Ave., Berkeley, Calif.
SYUCHI ISSIKI, Taihoku Imperial Univ., Taihoku, Formosa, Japan.
JOHN H. LILLY, College of Agriculture, Madison, Wis.
E. GORTON LINSLEY, 2050 Tenth Ave., Oakland, Calif.
H. MENUSAN, JR., Bailey Hall, Ithaca, N. Y.
HELEN D. O'NEIL, Mount Holyoke College, South Hadley, Mass.
W. L. PUTMAN, Dom. Ent. Lab., Vineland Station, Ontario, Canada.
CURTIS W. SABROSKY, Dept. Ent., K. S. C., Manhattan, Kansas.
OSGOOD R. SMITH, Cornell University, Ithaca, N. Y.
LEE A. STRONG, Bureau Entomology, U. S. D. A., Washington, D. C.
M. R. CHAKRATONG TONGYAI, 301 Bryant Ave., Ithaca, N. Y.
EDWARD H. WILSON, North Amherst, Mass.
HENRY K. TOWNES, JR., Ent. Dept., Cornell Univ., Ithaca, N. Y.

Total new members for 1933—35.

The following have resigned during the year: HOWARD E. DORST, J. ALFRED ADAMS, S. C. CHANDLER, E. J. SCHAEFER, P. K. HARRISON, W. A. STEVENSON, FRANCIS H. WILSON, ARTHUR M. PHILLIPS, CLARENCE R. CLEVELAND, THOMAS M. STREET, RALPH L. MILLER, S. M. DOHANIAN, CLARENCE A. CROOKS, SAM O. HILL, W. RUSSELL JONES, EDWARD W. JONES, A. C. COLE, JR., C. K. SIBLEY, H. F. HUDSON, J. M. MCGOUGH, HORTENSE BUTLER HEYWOOD (Mrs. R. E.), EDWIN H. BRYAN, JR., NEAL E. EVANS, FRANCIS H. SUMNER, O. A. STEVENS, C. F. ADAMS, ARLO M. VANCE.

The following have been automatically dropped from the membership, either because of failure for three or more years to pay dues or because they cannot be reached: T. R. ADKINS, IRA W. BERRYHILL, O. E. BOOTH, MYLES F. BOWEN, H. L. CALER, CARLOS CAMACHO, SAMUEL E. CASSINO, ANDREW J. CHAPMAN, JOHN F. CHRISTENSEN, CLARENCE P. CUSTER, E. HOYT DEKLEINE, NELSON L. DOUGLASS, WALTER HENRY DOVE, OTIS E. GAHM, HENRY G. GOOD, CHRISTINE N. HARDY, THOMAS V. HENNEBERRY, J. R. HILTZ, L. L. HUBER, LUTHER G. JONES, G. LAGAI, E. M. R. LAMKEY, E. L. MAYNARD, ROGER L. PRESTON, HERALD K. RIPPEY, S. S. SHEFFIELD, C. H. SMITH, ELLISON A. SMYTH, JR., HENRY A. STABE, L. LAGRANDE STIRLAND, CHESTER A. SWINYARD, FRED W. WALKER, JOHN B. WALLIS, L. B. WALTON, ALFRED WEED, J. M. YEATES, MARTIN T. YOUNG, M. J. ELROD, F. K. STOFFERS, L. FLOYD CLARKE.

Total membership of Society—922.

The following were elected to the Editorial Board for the term expiring December 31, 1936: A. L. STRAND, E. M. WALKER and C. H. RICHARDSON.

In regard to the reorganization of the National Research Council, as recommended by our Executive Committee in December, 1932, it must be reported that DOCTOR FRANK E. LUTZ, Representative of Group VIII, presented our recommendations at the meeting of the Division on April 22, 1933. After some discussion the matter of representation within the Groups was laid on the table for the present.

The Executive Committee voted to contribute $10.00 toward the expenses of the Biologists' Smoker.

The Executive Committee recommended to the Society that our present "Committee on Insect Collections" be discontinued and replaced by a "Joint Committee on Insect Collections of America." This joint committee to consist of six members, three of which shall be elected by the Entomological Society of America and three by the American Association of Economic Entomologists. This committee shall choose its own chairman. Two members of the committee, one from each society, shall be replaced or re-elected each year. That in establishing this committee, the Nominating Committee be requested to bring in three nominations for the personnel of this committee, one to serve one year, one to serve two years, and one to serve three years.

The Executive Committee adjourned at 6:00 P. M.

The Society has suffered the loss by death of the following twelve members during the past year:

FRED ERNEST BROOKS, a charter member of our Society, died March 9, 1933, after several years of ill health. He was born at French Creek, W. Va., on June 8, 1868. Beyond the common schools of West Virginia he was trained by his own industry. As a fruit grower he gained experience in the control of insects and in 1902 became associated with the West Virginia Agricultural Experiment Station. From 1911 until 1928 he was an Associate Entomologist of the Bureau of Entomology, resigning in 1928 on account of his poor health. His best known work was with wood-boring and nut infesting insects. Cutright in the *Journal of Economic Entomology* says of Mr. Brooks: "In his passing, entomology loses a diligent and successful worker; the State, a conscientious and active citizen; and his friends, a friend indeed."

NORMAN CRIDDLE,* of Treesbank, Manitoba, Canada, died May 4, 1933. Mr. Criddle was a charter member of our Society and known to many of us by his work on grasshopper control and his interest in the Orthoptera in general. He was, however, a naturalist of wide interests, a talented artist and a man of charming personality. He possessed a wealth of information about the habits of wild mammals and was interested in Ornithology from his boyhood days. His Canadian colleagues have referred to him as "the best informed field Naturalist in the whole of Canada."

Mr. Criddle's artistic ability is shown in the illustrations which accompanied his papers and in the colored drawings of weeds and weed seeds in "Farm Weeds," by Clarke and Fletcher, a splendid publication of the Dominion Department of Agriculture.

*For a more complete account, see Can. Ento. LXV, No. 9, pp. 193–197.

Mr. Criddle was born at Addlestone, Surrey, England, on May 14, 1875, and came with his parents to Canada in 1882. The family settled on a farm near Aweme and he received his early training from his parents, both of whom were highly educated Until 1905 he remained at home assisting in the work of the farm, then he was called to Ottawa to complete colored drawings for "Farm Weeds" through the influence of Dr. James Fletcher, who had recognized the young man's ability by a former visit to the farm home some five years before. For the following four years he was employed by the Dominion Seed Commission to collect weed seeds. In 1913 he received a temporary position as Entomological Field Officer of Manitoba. This became permanent the following year.

Through the death of Mr. Criddle, the Society has lost a valuable member and those who knew him personally, a delightful friend.

JOSEPH EDWARD HALLINEN, of Cooperton, Oklahoma, was born in Champaign, Illinois, March 23, 1859, and died at Hobart, Oklahoma, February 13, 1932, in the seventy-third year of his age. In 1876 he entered the University of Illinois, but left the following year to teach in Champaign County Schools, work which he continued until 1890, when he again entered the University. In 1891-92 he was an assistant in the Illinois State Laboratory of Natural History. He was graduated with the degree of B.S. from the University of Illinois in 1894 and the following year was a graduate student in biology at the University of Chicago. Thereafter he served as a teacher of Science in the High Schools of Ottawa, Illinois, and Fort Smith, Arkansas. In 1901 he became a teacher of physics at the University of Oklahoma. For many years he spent his vacations on his farm near Cooperton, Oklahoma, which he maintained as a wild life preserve, using it as a scientific laboratory. His last seventeen years were spent in retirement on his farm where he studied, made notes on his observations of bird and insect life. His comment on the card in our file says, "All is fish that comes to my net." His library of 5,000 books and pamphlets has been acquired by the University of Oklahoma. As far as I can discover he never published any of his observations, but his interest in entomology is indicated by his membership in our Society since 1914.

WILBUR LAURIN HUTCHINSON, JR., a physician of Hazleton, Pa., and a member of our Society since 1925, died March 20, 1933. After graduating from Hazleton High School in 1917, he entered the pre-medical course at Franklin and Marshall College, Lancaster, Pa. He completed the medical course at Jefferson Medical College of Philadelphia, Pa., in 1923. After a year's internship at the Lancaster General Hospital he spent five years in general practice at Conyngham, Pa., and then did post-graduate work in Surgery at the University of Pennsylvania, following which he became surgical resident at Easton Hospital, Easton, Pa. Dr. Hutchison had a natural interest in entomology and was fond of his collection of insects which was a hobby with him.

ALONZO W. LOPEZ, of Manila, Philippine Islands, died on November 2, 1932, shortly after returning to California from the Philippines. Mr. Lopez joined the Entomological Society of America in June, 1930. As Chief Entomologist of the Philippine Sugar Association he was interested in various Sugar Cane Insects and was active in the introduction of Scoliids from Australia. He received his B. S., 1926 and M. S., 1928, from the University of California. He was born at Santa Ana, California, August 23, 1900, and began his work in the Philippines in July, 1929. This work he was forced, by ill health, to relinquish in 1932, after making considerable progress on a difficult and long time project.

WILLIAM DENMARK MCILROY, JR., one of our young members, died December 15, 1932. He became a member of our Society in December, 1929. He was born December 11, 1906. After completing his high school course at Pittsburgh, Pa., he entered the University of Pittsburgh. From this institution he received the B.S. degree in February, 1930, and his M.S. in February, 1931. His Ph.D., which he had fully earned before his untimely death, was granted in February, 1933, posthumously. Mr. McIlroy was a graduate assistant at the University of Pittsburgh and was considered by the Entomological Staff at the Carnegie Museum to be a most promising young man. It is most regretable that a scholar so well prepared for a productive scientific career should be taken by such an early death.

CLARENCE R. PHIPPS, who died June 21, 1933, was born in 1895. He received his degree of B.S. from the Massachusetts Agricultural College in 1919, his M.S.

from Iowa State College in 1927, and his Ph.D. from Cornell University in 1930. From 1919 to 1921 he was assistant entomologist at the New York Experiment Station, Geneva, N. Y. From 1922 to 1925 he held the position of Entomologist at the Missouri State Fruit Experiment Station. Since 1925 he had charge of the Purnell Projects in the Department of Entomology at the Maine Agricultural Experiment Station. Throughout his entomological career he was concerned with fruit insect problems and the fruit growers wherever he worked appreciated his earnest efforts in their behalf. His praiseworthy papers on the apple and fruit fly and blueberry insects demonstrate his ability as an entomologist and his death is a loss to our science.

ARGYLE B. PROPER, who was to present a paper on our program at this meeting, died on December 16, 1933, after a week's illness. We deeply regret the untimely death of this promising young man. He was born March 4, 1905, in Sunapee, N. Y., and received his B.S. degree from the University of New Hampshire in 1926 and his M.S. degree in 1927. On July 1, 1927, he became Junior Entomologist at the Gipsy Moth Laboratory, Melrose Highlands, Mass., where he was employed at the time of his death. His work at the U. S. Bureau of Entomology consisted of biological investigations with leaf-mining insects and parasites, both primary and secondary, of forest insect defoliators. The progress he made in these studies were very pleasing to his co-workers and he will be greatly missed by them.

He joined our Society in 1928 and has shown an active interest in its welfare. His death brings an unusual shock to our Society at this Boston meeting.

CHARLES FREDERICK CURTIS RILEY. The November number of "The Entomologist" in its report of the Royal Entomological Society of London announced the death of C. F. Curtis Riley. Doctor Riley was a charter member of our society. He was born in Manchester, England, 1872. He received the following degrees: Doane College, A.B., 1901, A.M., 1913, Sc.D., 1932. Michigan University, B.S., 1904. He also attended Nebraska and Illinois Universities. According to American Men of Science he held the following positions: Asst. biol., astron. and meteor, observatory, Doane College, 1897–1900; prin. and instr., high schools, Nebraska and Indiana, 1901–02, 1904–05; asst. zool., Michigan, 1902–04; acting head dept. biol., Minn. State Teachers College, Duluth, 1905–06; prof. and head dept. nat. sciences, Kansas State Training College for Teachers, Pittsburg, 1906–07; head dept. biol. and curator museum, Minn. State Teachers College, Mankato, 1907–11; asst. zool., Illinois, 1911–12; head dept. biol., Wis. State Teachers College, Milwaukee, 1913–17; asst. prof. and special lecturer animal behavior, N. Y. State College Forestry, Syracuse, 1917–18; asst. prof. forest zool., 1819–19, prof., 1919–20; asst. prof. zool., Manitoba, 1920–. Doctor Riley was a member of many scientific societies and wrote numerous articles on the ecology, distribution and habits of aquatic insects. His special interest was in the Gerridae.

ANTHONY SPULER, of Wenatchee, Washington, and his wife drowned in Lake Wenatchee in the summer of 1932, but this information did not reach your Secretary in time for last year's report. Mr. Spuler was born in Genesee, Idaho, December 19, 1889. He began his entomological training under Dr. A. L. Melander at the State College of Washington in 1909. After some years away from college he returned, completed his work and received his Master's degree in 1919. As a student his interest was in systematic entomology. During his professional career he was engaged in the control of fruit insects. He developed the apple poison bait for strawberry weevil, the method of observing codling moth broods through the use of the moth trap and made careful studies of oils and arsenicals as insecticides. The Washington State Horticultural Association in its proceedings say of Mr. Spuler, "He was indispensable to horticulture, and his death constitutes a well nigh irreparable loss."

HENRY FREDERICK WICKHAM died November 17, 1933. Professor Wickham was a charter member of our Society and elected to Fellowship in 1914. He was born in Shrewton, England, October 26, 1866. He attended Iowa University from 1887–91 and received his M.S. in 1894. From 1891 to 1927 he was Assistant Curator of the Zoological Museum of the University of Iowa. From 1894–1903 Assistant Professor of Zoology. From 1903–, Professor of Entomology at Iowa University. Professor Wickham was interested in the coleoptera and their distribution. He was a member of the Washington Entomological Society, the

Ontario Entomological Society and the Soc. entom. de Belge, as well as a loyal supporter of the Entomological Society of America since its foundation. The death of Professor Wickham robs our Society of another charter member and a friend of many years.

EDWARD BRUCE WILLIAMSON, another charter member of our Society, died February 28, 1933, as a result of a severe paralytic stroke that had taken place on February 17th. Mr. Williamson, who for many years lived at Bluffton, Indiana, was known as a most enthusiastic student of Odonata. It was only in the last few years that he became associated with the Museum of Zoology at the University of Michigan, where his untiring industry and devotion to his dragon-fly studies became the admiration and inspiration of his museum colleagues. Through many years, a business man with dragon-flies as a hobby, he built up a splendid private collection. Planning and executing collecting expeditions for his vacation time and spending his leisure hours amongst his own collection, he became an authorative student in his chosen group. His death removes a most useful naturalist from our midst. (A detailed account will be published by the Zoological Museum, University of Michigan.)

Following the reading of these brief memorials the members stood in silence in memory of the twelve who have died during the past year.

It would be a matter of great interest to the Secretary to learn how many of our members are not professional entomologists but who have joined our society through an abiding interest in insect life.

It would also be helpful in the preparation of such a report as this if the members would report to the Secretary any deaths of members known to them.

Respectfully submitted,

H. B. HUNGERFORD, *Secretary.*

REPORT OF THE TREASURER.

CURRENT FUNDS.

RECEIPTS.

Balance in Bank, December 31, 1932 (See Annals XXVI, p. 189)	$2,100.35
From Annual Dues of Members to December 22, 1933	2,516.98
Received from C. H. Kennedy, Managing Editor Annals	400.00
Interest on Savings Account for 1933	86.27
Interest on Liberty Bonds	13.79
Total	$5,117.39

EXPENDITURES.

Stamps and Stamped Envelopes for Secretary-Treasurer and President	$ 91.03
Printing of Envelopes, Letterheads, Post Cards, Announcements, Programs, etc	63.95
Spahr & Glenn Co., Printing of Annals and Separates for December and September, 1932, March and June, 1933	3,155.47
Union of American Biological Societies	50.00
Reimbursements on Returned Checks	120.49
Exchange Charges on Checks	1.47
Miscellaneous Expenses, Rubber Stamps, Wires, etc	4.90
C. H. Kennedy (three numbers of Annals to Rivnay)	3.00
E. F. Phillips, half expense on "Special Committee"	20.82
E. P. Felt, half expense on "Special Committee"	19.84
Ernest N. Cory, half expense on "Special Committee"	1.70
J. S. Houser, half expense on "Special Committee"	23.24
Clerical Services	25.00
Federal Tax on Checks at .02 each	.52
Total	$3,581.43
Balance in Bank	1,535.96
	$5,117.39

LIABILITIES.

The Society owes the publishers for the September and December, 1933, Annals. Of the above cash receipts for dues, $1,077.95 is for 1934 dues.

PERMANENT FUND.

Liberty Bonds (Annals XXIII, p. 202)	$ 350.00
In Savings Account of Peoples State Bank, Lawrence, Kansas	2,670.29
	$3,020.29

RESOURCES.

Liberty Bonds	$ 350.00
Savings Account	2,670.29
Balance in Checking Account	1,535.96
	$4,556.25

In addition to the above the Thomas Say Foundation is in debt to the Society to the extent of $500.00.

Respectfully submitted,

H. B. HUNGERFORD, *Treasurer.*

On motion the Treasurer's Report was accepted, subject to the approval of the Auditing Committee.

REPORT OF THE MANAGING EDITOR OF THE ANNALS.

I wish to report 680 pages of matter published in Volume 26 for 1933. This is 260 pages less than the large volume for 1931. The September and December issues were cut to half the usual size and we cannot foresee more than 500 pages for Volume 27, 1934. We suggest that all members submitting matter to the Annals take time and make a real effort to condense articles as far as possible. It is only fair to those already doing so.

The first indication of better times to come is an increase in sales of back volumes of 25 percent over that of 1932. Income from subscriptions has fallen from $660.00 in 1932 to $480.00 in 1933, due mostly to unpaid accounts. The total income of this office has fallen from $2,530.00 in 1932 to $1,440.00 in 1933. This includes a loss of $500.00 received annually heretofore from the National Academy of Sciences and a much smaller amount due to the fact that, beginning with the June issue, the printers have handled the reprint accounts.

We wish to thank Mr. Birely J. Landis for steady assistance in the editorial work, Mrs. Elizabeth A. Davis for her perfect accounts this year. We wish to thank the following for payments of the printing costs of articles: T. D. A. Cockerell, The Rockefeller Foundation and the Department of Entomology, Iowa State College.

During the past year the Editors have made every effort to have manuscript condensed, some articles having been returned three times for changes. Smaller type has been used wherever possible. Keys and bibliographies have been standardized as well as subheads. Illustrations have been picked more carefully than ever before and some have had a small amount of retouching to raise their quality. The printers, Spahr and Glenn, have offered to meet any prices made by other publishing companies. The financial summary follows:

RECEIPTS.

From Non-member Subscriptions	$ 483.83
From Sale of Back Numbers	309.81
From Author's Reprints and Etchings	650.96
	$1,444.60
Balance in Bank, January 1, 1933	10.03
Total Receipts	$1,454.63

DISBURSEMENTS.

Engraving	$ 489.55
Wrappers and Stationery	69.65
Stenographic Services	272.40
Postage	124.89
Paid for Back Numbers	6.00
Work in Annals Store Room	12.00
Bank Charges, Exchange, etc	4.95
Rebate on Check to M. R. Smith	1.00
Three Checks to Treasurer	403.00
Total Disbursements	$1,383.44
Balance in Bank, December 12, 1933	86.96
Less Check not yet Deposited	15.00
	$1,454.63

Vouchers are submitted herewith.

Respectfully submitted,

CLARENCE H. KENNEDY, *Managing Editor.*

On motion the report was adopted subject to the approval of the Auditing Committee.

REPORT OF THE TREASURER OF THE THOMAS SAY FOUNDATION.

FOR THE YEAR 1933.

RECEIPTS.

Balance on hand, December 30, 1932	$190.79
Interest on Savings	2.00
Received from 1932 Sales of Volume 1	3.00
Received from 1932 Sales of Volume 3	12.00
1933 Sales of Volume 1 (3 copies)	8.70
1933 Sales of Volume 2 (4 copies)	18.50
1933 Sales of Volume 3 (12 copies)	44.00
Total Receipts	$278.99

EXPENDITURES.

Refund on Duplicate Payment	$ 4.00
Commission to C. C. Thomas on sale of six books	3.02
Postage on Volumes	3.65
Total Expenditures	$ 10.68
Balance in Purdue State Bank, December 20, 1933	268.32
	$278.99

There is a balance due on the loan from the Entomological Society of America of $500.00, $200.00 of which will be paid from the above balance, January 1, 1934.

Respectfully submitted,

J. J. DAVIS, *Treasurer.*

On motion the report was accepted subject to the approval of the Auditing Committee.

REPORT OF THE AUDITING COMMITTEE.

We, the undersigned members of the Committee on Auditing, beg to report that we, after a careful examination of the books of the Treasurer, the Managing

Editor of the Annals, and the Treasurer of the Thomas Say Foundation, have found them to be correct and properly balanced.

Respectfully submitted,

H. O. DEAY, *Chairman*,
D. M. DELONG,
P. A. READIO.

On motion the report of the Auditing Committee was accepted.

REPORT OF THE MEMBERSHIP COMMITTEE.

The Membership Committee wishes to report that 35 new members have been secured for 1933.

D. M. DELONG, *Chairman*,
E. O. ESSIG,
ROGER C. SMITH,
J. MCDUNNOUGH,
J. S. WADE,
O. I. SNAPP,
J. A. MANTER.

REPORT OF THE NOMINATIONS COMMITTEE.

The Nominating Committee begs to report the following names as nominees for the respective offices for the year 1934:

President—C. L. METCALF.
First Vice-President—E. P. VAN DUZEE.
Second Vice-President—J. MCDUNNOUGH.
Secretary-Treasurer—H. B. HUNGERFORD.
Additional Members of the Executive Committee—For the term expiring December 31, 1936: R. C. SMITH and F. E. BLAISDELL.
Councillors to the American Association for the Advancement of Science—P. J. PARROTT and J. J. DAVIS.
Members of the Joint Committee on Insect Collections of America[1]—For term expiring December 31, 1934, J. G. REHN; for term expiring December 31, 1935, J. MCDUNNOUGH; for term expiring December 31, 1936, C. F. MUESEBECK.

Respectfully submitted,

GEO. A. DEAN, *Chairman*,
P. P. CALVERT,
C. R. CROSBY.

On motion the report was accepted and the Secretary instructed to cast a ballot for the election of the persons nominated. This being done, they were duly elected.

The Committee on Insect Collections reported as follows:

REPORT OF THE COMMITTEE ON INSECT COLLECTIONS.

The response to our request for notes concerning advances in the building up of insect collections has been very gratifying in showing a number of decided advances. If these reports are read along with reference to those which have appeared in the past decade, one may form a very interesting picture of the status of insect collections throughout the country and their place in entomological study. We have attempted to secure data from all institutions maintaining collections but will be thankful for information concerning any not reached.

U. S. National Museum, Washington, D. C.: I am sure you will be interested in the fact that on September 12, 1933, we recorded the 50,000th species of insects represented by type material in this Museum. We passed the number 25,000 on October 31, 1921; so you can see how rapid the accumulation has been. We have

[1]Additional members of the Joint Committee on Insect Collections of America, elected by the American Association of Economic Entomologists: For term expiring December 31, 1934, C. P. ALEXANDER; for term expiring December 31, 1935, C. E. VAN DYKE; for term expiring December 31, 1936, T. H. FRISON.

received one considerable collection during the year, that of Professor Edward T. Owen, of Madison, Wisconsin. The executors of his estate donated the collection to this Museum. It comprised about 40,000 specimens of Lepidoptera in 16 large cases. There were many species new to our collection, from various parts of the world; and others which had been poorly represented here. Aside from this one addition we have received about the usual number of specimens from various collectors and by transfer from the Bureau of Entomology; nothing however which seems to call for especial comment.

J. M. ALDRICH, *Associate Curator*, Division of Insects.

Canadian National Collection: The most important additions made to the collection since the last report in 1932 have come as results of the insect faunal surveys carried on by the Entomological Branch. Surveys were carried on in the Gaspe peninsula of Quebec, in the Bobcaygeon, Ottawa, and Georgian Bay districts of Ontario, and in British Columbia. The following groups were given special attention: Lepidoptera, Ephemeroptera, Coleoptera, and parasitic Hymenoptera. New steel cabinets containing 150 drawers and a new cabinet for alcoholic specimens have been acquired for the new material. At present the collection contains type material for 3,672 North American species.

J. M. MCDUNNOUGH.

The American Museum of Natural History, New York: Mr. Willis J. Gertsch, who joined the staff of the American Museum of Natural History in 1932 to take charge of the spiders, now has the collection well arranged. It consists of about 100,000 specimens. In spite of decreased appropriation, the Museum's entomological work has continued. The major field-trip was by Messrs. Huntington, Lutz and Schwarz to Panama. From various sources the type collection has been enriched by about 200 species. As in previous years Mr. Mutchler has edited the Coleoptera section of Biological Abstracts. Mr. Curran has completed the manuscript of a monograph of the genera of North American Diptera.

FRANK E. LUTZ.

Alabama Polytechnic Institute, Auburn, Alabama: We have added to our collection some four hundred or more specimens of beetles, particularly Cerymbiscidids, Carabids, Chrysomelids, Cicindelids, Histerids, Tenebrionids and Coccinelids. A portion of these specimens came in exchange from California, the greater amount of them, however, came from Mr. H. P. Loding, Mobile, Alabama, who is rearranging his beetle collection.

J. M. ROBINSON, *Head*, Department of Zoology-Entomology.

University of Colorado, Boulder, Colo.: The collection is in the care of the University of Colorado Museum. It is housed in 261 Schmitt boxes, 55 glass-topped cases, and two cabinets. During the last year nearly 11,000 specimens have been added, bringing the total of the collection to about 27,000 specimens. [The first number in the following list determined, the second undetermined.] Orthoptera, 2,607, 179; Neuroptera, 69, 85; Trichoptera, 76, 42; Odonata, 139, 204; Hemiptera-Homoptera, 455, 744; Coleoptera, 1,272, 3,378; Lepidoptera, 1,353, 4,971; Diptera, 2,802, 1,868; Hymenoptera, 3,185, 4,578. These totals do not include Professor Cockerell's personal collection, nor the material for student use.

HUGO G. RODECK, *Curator*.

Illinois State Natural History Survey, Urbana, Ill.: This year the principal additions to the Survey collections have been about 1,000 pinned specimens of Miridae, 4,000 pinned specimens of miscellaneous insects and about 600 vials of Plecoptera, Trichoptera and other aquatic insects in alcohol. The employment of a Berlese apparatus has added in addition a very large number of insects, notably about 200 vials of Collembola and Thysanura, 200 vials and 300 pinned specimens of Formicidae, and 250 vials of other adult insects, this last comprising about 5,000 specimens at present in alcohol. Dr. M. D. Farrar has made 160 collections of Thysanoptera, representing many individuals and species, most of the material unmounted as yet. Four hundred slides of Aphiidae, Thysanoptera and Mallophaga, 200 of Siphonaptera and 500 of Coccidae have been added to the collection. Type specimens have accrued of the following number of species: Aphiidae, 19 species; Tenthredinoidea, 3; Plecoptera, 4.

H. H. ROSS, *Systematic Entomologist*.

Indiana University, Bloomington, Ind.: General teaching collection gradually augmented. Gall wasp collections increased by 30,000 insects, chiefly to show the relations of the faunas of glaciated and non-glaciated areas in Wisconsin and in Ohio.

ALFRED C. KINSEY, *Professor of Zoology.*

Boston Society of Natural History, Boston, Mass.: The principal additions to the collection since the death of its beloved curator, Mr. C. W. Johnson, are the Tabanidae of the late C. P. Whitney and a duplicate set of spiders from the collection of J. H. Emerton. The latter gift was made by Mr. Nathan Banks. The society is fortunate in having close at hand many prominent entomologists whose time and material are generously contributed.

RICHARD DOW, *Assistant Curator of Insects.*

Museum Comparative Zoology: About 90,000 specimens have been received during the year. The largest single gift is the collection of Coleoptera of the late J. G. Goering; this contains fully 35,000 beetles; many from the Southwest are especially useful to us. Mr. H. Stevens, who collected in New Guinea, sent us about 15,000 insects, 7,500 of which are Lepidoptera. Mr. Darlington presented several thousand insects collected last June in Brownsville, Texas, also several thousand Neotropical Coleoptera. Mr. Bates has given about 2,000 miscellaneous insects from Florida and Central America. Dr. Bequaert, as usual, has given parts of his collection, fully 3,000 specimens, mostly Syrphidae and Tenthredinidae. The Director purchased over 6,000 insects from A. Jourin, of Sumatra, and over 8,000 from R. Stadelmann, of Honduras. Mr. J. B. Edwards sent 1,000 insects from central Honduras, and more than 4,000 came from P. de Mesa, of Mindaro, Philippines. Mr. Greenway presented over 1,000 specimens taken in the southern Bahamas during the voyage of the Utowana. The Curator has given about eight or ten thousand spiders from the J. H. Emerton collection.

Although not all of the insects of the Harvard Australian Expedition have been mounted, the collection will run considerably above the 50,000 specimens previously estimated. We now have the types of over 18,000 species of insects numbered and catalogued on cards, over 1,000 more yet to be done.

NATHAN BANKS, *Curator.*

University of Minnesota, St. Paul, Minn.: Approximately thirteen thousand insect specimens have been added to the collection during the past year. These have been acquired through gifts, purchases, exchanges and miscellaneous collecting in the state. The most important purchase was 400 specimens of identified Brazilian Lepidoptera. During the year, 10,000 specimens of Dytiscidae, Haliplidae, and Gyrnidae were returned after having been studied and identified by Mr. J. B. Wallis, Winnipeg, Canada. It is planned to publish a state bulletin on the results of Mr. Wallis' work. The flies of the family Stratiomyiidae have been studied, identified and returned to the collection by Mr. Maurice T. James. An attempt is being made to build up the collection of spiders for the state and the material is being identified as fast as collected by Mr. W. J. Gertsch. The insect specimens collected in the South Seas by the later Professor Washburn have been placed in the hands of the Bernice Bishop Museum, Honolulu, Hawaii, for study, and it is expected that a paper giving the results of this study will appear within a year or so. During the summer of 1932 a brief survey of the Orthoptera of the state was made on account of the serious outbreak of grasshoppers in many parts of the state. About four thousand specimens were collected, four species heretofore not known in the state were discovered and the distribution of injurious species was mapped. All of the specimens collected on this survey, as well as all other Orthoptera in the Minnesota collection, were studied by Mr. Morgan Hebard and the results of his work have been published in Technical Bulletin 85, of the Minnesota Agricultural Station. It is planned to send additional groups of material to specialists for study during the coming year.

CLARENCE E. MICKEL, *Associate Professor of Entomology.*

Montana Agricultural Experiment Station, Bozeman, Montana: Work on the arrangement of the Montana Agricultural Experiment Station insect collection has been continued during the past year. The collection is housed in twelve cabinets containing 344 glass-topped trays. Ample space is provided for expansion. Up to June, 1933, the following groups had been systematically arranged

according to the authority quoted: Orthoptera, Morgan Hebard, Ref. The Orthoptera of Montana, Proc. Acad. Nat. Sci., Philadelphia, Vol. LXXX, 1928, 211-306; Gen. 64, Sp. 135; Out of State Gen. 108, Sp. 194; Phalaenidae, W. C. Cook, Arranged according to Barnes and McDunnough Check List, Montana Gen. 241, Sp. 846, Out of State Gen. 22, Sp. 57; Hemiptera, Arranged according to Check List of Hemiptera of America North of Mexico. Van Duzee, Montana Gen. 75, Sp. 119, Out of State Gen. 45, Sp. 55; Homoptera, see Hemiptera, Montana Gen. 48, Sp. 94, Out of State Gen. 3, Sp. 3; Coleoptera, Arranged according to Leng's Catalog, Montana Gen. 297, Sp. 642, Out of State Gen. 584, Sp. 1130; Diptera, Arranged according to Catalog of North American Diptera, Montana Gen. 238, Sp. 488, Out of State Gen. 43, Sp. 103; Hymenoptera, Arranged according to Hymenoptera of Connecticut, Montana Gen. 75, Sp. 215, Out of State Gen. 35, Sp. 77. The following specialists have worked on the groups indicated: Orthoptera, Morgan Hebard; Hemiptera-Homoptera, Van Duzee, Knight, Drake; Coleoptera, Henshaw, Hatch, Blake, Frost, Knull, F. S. Carr, Ballou, M. Lane, Hyslop, R. Dawson, Beller, Zimmerman, Blackman; Diptera, Aldrich, R. R. Parker, C. B. Philip, W. V. King, Dyar, Curran, Hine, Wilcox, C. L. Metcalf, Malloch, F. L. Thomas, Hearle; Hymenoptera, Cooley, Viereck, Hooker, Gahan, Mickel, Regan, Fernald, Mitchell, Sandhouse, Cockerell, Franklin, Wheeler, M. R. Smith. During the past summer the following groups have been returned credibly named, but have not yet been incorporated into the general collection: Formicidae, Asilidae, Tabanidae and Megachilidae. Also Philanthidae.

J. H. PEPPER, *Assistant Entomologist.*

North Carolina State College, Raleigh, N. C.: Our personal additions to our collection this past year have been chiefly from North Carolina, Southwestern United States, Central America and Cuba. Z. P. METCALF, *Entomologist.*

Ohio State University, Columbus, Ohio: Professor Herbert Osborn has donated his private collection of Hemiptera and the Trustees of the University in accepting the gift have made provision for a permanent curator and additional housing equipment for these and other collections belonging to the institution. The Osborn collections include material he has gathered from boyhood up to the present and represent localities throughout the U. S. and Mexico, West Indies and Central America with some European, and also extensive collections secured by purchase or exchange and especially rich in Neotropic material with some from Oriental and Ethiopian regions. There are also many types of species described in his technical papers. Among other important series in the Department are the collections of Odonata and Lepidoptera made by Kellicott, the Tallant collection of Lepidoptera including many exotic, and the Wenzel collection of Coleoptera. Mr. J. N. Knull, formerly with the Bureau of Plant Industry of Pennsylvania has been secured as curator and will assume his duties in January. With this assurance of permanence it is certain that other collections will be added and already some important gifts are assured. With a room and equipment especially designed for the housing of the insect collections we may expect rapid growth and greatly increased facilities for taxonomic and faunistic research.

DWIGHT M. DELONG.

Academy of Natural Sciences of Philadelphia: Since December 1, 1932, there has been added to the insect collection nearly 6,500 specimens, the more noteworthy of the accession lots being: 1,546 North American Lepidoptera, by bequest of the late Dr. W. D. Dietz; 1,319 of various orders from Siam, secured by the De Schauensee-Sinkler Expedition; 517 Orthoptera from the United States, Persia, Syria and Iraq, from Mr. Morgan Hebard; 360 Lepidoptera from British Guiana and Ecuador, from Mr. W. J. Coxey; 415 Lepidoptera from Nyassaland, from Mrs. H. V. Wise; 265 of various orders from northern Guatemala and southern Mexico, from D. W. Amram, Jr.; 100 slides of Thysanoptera, from J. B. Steinweden; and 1,072 specimens, chiefly Lepidoptera and Orthoptera from Africa, S. E. Europe and the United States, received in exchange from three sources. Smaller lots of general material from extreme northern British Columbia, taken by Miss Josephine deN. Henry; from southern Florida, taken by Mr. F. M. Jones, and several series of Asiatic *Parnassius* from Dr. Levi Mengel, and of west American Coleoptera from Dr. F. E. Blaisdell, were of particular interest. In spite of prevailing economic conditions it has been possible to add additional units to the series of newly

designed steel housing cabinets, with which the previously used Skinner tins are being replaced. These new cases, made of welded automobile body sheet steel, are but one of four types of such equipment recently developed by the Academy for natural history collections, and which are produced at figures much more satisfactory than previously possible. Box housing facilities equal to the capacity of the new cabinet units have also been provided. Rearrangement has made the entire series of Lepidoptera, as far as studied, more readily accessible, while similar work has added materially to the facility with which the representations of other orders may be consulted. JAMES A. G. REHN, *Curator*.

South Dakota State College, Brookings, S. D.: During the past year, approximately 10,000 pinned specimens of insects were added to our collections. Our collections of Orthoptera are represented by several hundred thousand specimens, most of which were taken in the United States, but the collections include many hundred species from other countries in addition. During the year 1933 considerable progress was made in the identification of our Coleoptera and Diptera. Meloidae were collected in abundance in South Dakota during the past year as a part of the work of an experiment station project, but some of these Meloids will be used for exchange purposes.

H. C. SEVERIN, *Head*, Entomology-Zoology Department.

The State College of Washington, Pullman, Wash.: The collection of Lepidoptera now contains more than 12,000 specimens, representing approximately 1,500 different species. This has been accumulated mostly during the last few years by J. F. Gates Clarke, of the Department of Zoology.

R. L. WEBSTER, *Head*, Department of Zoology.

The Francis Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kans.: During 1933 additions of exotic material have been made from Cuba, Mexico, Central America, South America, Australia and Sumatra. The additions of North American insects are as follows: Determined specimens 11,938, belonging to 789 species of which 587 species are new to the collection and 86 species new to science. New type species are distributed as follows: 7 Coleoptera, 5 Hemiptera, 55 Homoptera, 15 Diptera, 2 Hymenoptera, 2 Orthoptera. Undetermined specimens: about 10,000 mostly from the Western United States, taken by Dr. R. H. Beamer. H. B. HUNGERFORD, *Curator*.

Aside from these reports we have had responses from several institutions with the statement that no additions of especial importance have been made during the year.

It has been suggested by President Hinds of the Association of Economic Entomologists that the respective committees in the two societies act as a joint committee and we recommend that the committee be authorized to act in such manner or to arrange for such co-operation as seems desirable.

Committee: HERBERT OSBORN, *Chairman*,
NATHAN BANKS, JAMES A. G. REHN,
J. G. NEEDHAM, EDWIN C. VAN DYKE.

REPORT OF THE SPECIAL COMMITTEE FOR INVESTIGATION OF REORGANIZATION OF ENTOMOLOGICAL RESEARCH IN THE FEDERAL GOVERNMENT.

A report read by the Chairman and filed with the Secretary was signed by:

E. F. PHILLIPS, *Chairman*,
W. E. BRITTON, E. P. FELT,
E. N. CORY, J. S. HOUSER.

REPORT OF COMMITTEE ON INTERNATIONAL ORGANIZATION OF ZOOLOGISTS.

A report read by the Chairman and filed with the Secretary was signed by:

J. C. BRADLEY, *Chairman*,
C. P. ALEXANDER, HAROLD MORRISON,
G. F. FERRIS, J. M. SWAINE.

While the President did not appoint a Resolutions Committee, he expressed on behalf of the Society its appreciation to C. W. COLLINS, W. D. WHITCOMB, and C. T. BRUES, who served as a Committee on Local Arrangements; to the Harvard University for its hospitality; and to the Special Committee on Entomological Work in the Department of Agriculture and in the States, the membership of which was as follows: E. F. PHILLIPS, Chairman; W. E. BRITTON, E. N. CORY, E. P. FELT, and J. S. HOUSER.

FRANK E. LUTZ, representative to the National Research Council, gave a brief report and by vote of the Society Doctor Lutz was re-elected representative of the Entomological Society for another three-year period.

Attention was called to the next International Congress of Entomologists which will be held in Madrid, Spain, and J. C. BRADLEY was authorized to choose a committee to represent our Society in plans for this Congress.

PRESIDENT SNODGRASS read an invitation from the Entomological Society of London to participate in the Celebration of the Centenary of that Society. Since this celebration was to take place on May 3rd and 4th, 1933, DOCTOR EDWIN C. VAN DYKE, Professor of Entomology at the University of California, was appointed official representative of the Entomological Society of America. PRESIDENT SNODGRASS then displayed a copy of the Greetings from the Entomological Society of America to the Entomological Society of London.

The Society voted to accept the recommendations of the Executive Committee for the establishment of a Joint Committee on Insect Collections of America.

Following the transaction of the above business, the meeting adjourned.

Thanks to the activities of the local members of our Society, an unusually interesting collection of exhibits was presented.

The Entomologists' Dinner, held at 6:00 P. M. on Thursday evening, was a very pleasant affair and after a very short intermission was followed by the Annual Public Address given by DOCTOR FRANK E. LUTZ, whose subject, "What's the Use?" was admirably adapted to the occasion.

Respectfully submitted,

H. B. HUNGERFORD,
Secretary.